BULLETIN No. I.

NOTES

ON THE

MINERAL DEPOSITS

OF THE

ANGLO-EGYPTIAN SUDAN

BY

STANLEY C. DUNN

A.R.S.M., F.G.S., A.I.M.M.

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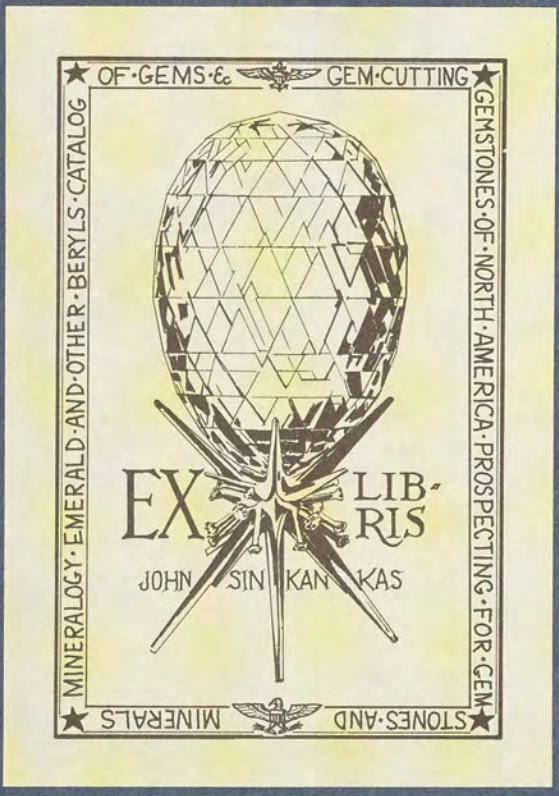
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PREFACE

SINCE 1900 many prospectors have visited the Anglo-Egyptian Sudan on behalf of mining syndicates, and it is principally with material culled from such reports they made that are now available that this bulletin is composed. Wherever possible, extracts and summaries are given in the actual words of the writers, and I cannot be held responsible for their information or opinions. The documents are filed in the Legal Department, and I am indebted to the Legal Secretary for permission to make use of them.

An account of the history and method of ancient mining in the Sudan until the tenth century shows the activity once displayed and the wealth produced. A short summary from Bergrath Russegger's *Travels in the Sudan* is given, since he visited this country simply in search of the mineral wealth, and therefore ranks as the first "prospector." He had a very exaggerated idea of the value of the deposits he discovered or was informed about, as the modern prospectors' accounts of the deposits show.

All information that could be discovered in books of travel, or in official reports on deposits other than those mentioned by the prospectors, is rather scanty so far.

As the maps show there remains the greater proportion of the country still to be prospected for minerals, and the extended observations of Government officials and travellers in all parts of the country promise greatly to increase our knowledge within the next few years.

THE ANGLO-EGYPTIAN SUDAN.

Scale 1/8,000,000

100 50 0 200 300 MILES.

NUBIAN SANDSTONE

SOIL PLAINS & SWAMPS

PLEISTOCENE DEPOSITS

IGNEOUS & METAMORPHIC

EGYPT

ANCIENT GOLD MINES

GOLD

SALT

GYPSUM

LIMESTONE

COPPER

NATRON

IRON

LEAD

LIGNITE

KOROSKO
WADI ALLAGI
C. ELBA
DEREHEIB
HALFA
ONIB
OM NABARDI
KOSHA
DALGO
PORT SUDAN
SUAKIN
ABU HAMED
DÔNGOLA
MEROWE
KOSTI
DEBBA
BERBER
TOKAR
RAS KASAR
JAKDUL
ATBARA
J. BAYUDA
RIVER ATBARA
WADI MELH
ELAI
METEMMA
GOZ REGEB
OMDURMAN
KHARTOUM
KASSALA
KHOR GASH
KAMLIN
WAD MEDANI
R. SETIT
ERITREA
J. KUTUM
EL FASHER
DUEIM
BARA
UM DAM
EL OBEID
JEBEL MARRA
DARFUR
NAHUD
BILLING
TAGALE
TANDIK
RENK
WHITE NILE
BLUE NILE
ROSEIRES
GONDAR
L. TSANA
SHEIBUN
TIRA MANDI
TALODI
FAZOGLI
BENI SHANGUL
MELUT
KODOK
KIRIN
BLUE NILE OR ABAI
WADI IBAR
R. UMBELASHER
HOFRAT EL NAHAS
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LAKE NO
BAHR EL HOMR
BAHR EL GHAZAL
R. SOBAT
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ABYSSINIA
R. BONGO
R. JUR
MESHRA EL REK
GAMBELA
WAU
DEIM ZUBEIR
TONJ
SHAMBE
LAO RIVER
BAHR EL JEBEL
BOR
FRENCH CONGO
LADO
MONGALLA
GONDOKORO
LAKE RUDOLF
YEI
CONGO FREE STATE
UGANDA
VICTORIA NILE
ALBERT NYANZA

20° 28° 29° 30° 31° 32° 33° 34° 35° 36° 37° 38° 39°

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THE MINERAL DEPOSITS OF THE ANGLO-EGYPTIAN SUDAN

GENERAL ACCOUNT

THE area of the Anglo-Egyptian Sudan is 5,624,000 square kilometres, one-third the area of Europe and about two and a half times the area of Egypt.

It can be stated roughly that the Nubian Sandstone reaches as far south as the 14th parallel of latitude. Igneous and metamorphic rocks cover an enormous area in the eastern portion between the Nile and the Red Sea, and outcrop among the sandstone over the entire extent of its deposit in this country, particularly near the cataracts of the Nile and in the Butana, east of Khartoum.

Gneisses and schists apparently form the main extent of the surface south of the 14th parallel of latitude. In central Kordofan schists and later igneous intrusions form hills, isolated or in ranges, covering some hundreds of square miles, and rising to heights of over a thousand feet above the general level of the plain. In the Bahr-el-Ghazal and Mongalla provinces, schists and gneisses prevail.

Coal.—Impure lignite of rather poor quality was discovered in Dongola, very near the surface of the ground. The geology of the district does not point to there being any workable deposits here. Coal of good quality is known to exist at several places in Abyssinia, the nearest site to the Sudan frontier being Chelga, north of Lake Tsana, near Gallabat. So far as the geology of the Sudan is known with certainty, there is little chance of finding large deposits of this important material.

Copper.—The most famous deposit of this metal in the Sudan for many years is the copper ore of Hofrat-el-Nahas. The mines lie about one mile west of the river Umbel-asher, a tributary of the Bahr-el-Arab, and consist of a large number of shallow pits covering an area of about half a square mile.

In places the ore sticks up in ridges above the surface.

Natives, probably for centuries, have worked the deposit, and copper in the form of rings weighing from 10 to 12 pounds, or in small ingots, was an article of barter in Darfur and western Kordofan. According to Russegger the copper was found in the native state in small granules; otherwise he was unable to account for the purity of the metal, since the crude methods of native smelting were, in his opinion, incapable of producing it. Samples of ore recently collected show it to be silicate and carbonate of poor quality generally, but selected specimens brought in by Colonel Sparkes in 1903 assayed 14 per cent. of pure copper.

During the Mahdist revolt the workings were abandoned. Colonel Sparkes, the first European to visit the locality since Purdy's expedition in 1876, found no natives living within thirty miles, but traces of a large population of many years ago. He describes the country as quite abandoned; and it is evident that if the mines, which are far from being worked out, are restarted, that transport, though possible apparently on the Bahr-el-Arab during some parts of the year, will be a matter of great difficulty.

Gold.—Every known deposit of the precious metal is described in the mining prospectors' reports. The history of gold mining in the Sudan shows to what an extent the mines in the Etbai and Dongola were worked, when labour was cheap, the metal was worth more than at the present time, and when it is possible that the climatic conditions were considerably different to those that now exist. The rainfall in the northern part of the Sudan must have been far greater when the mines were originally worked; not only are there many wells now dry, but traces of reservoirs and even of cultivation where now one or two storms of rain during the year is the maximum supply.

Om Nabardi Mine is now the only place in the Sudan

where gold is being produced by mining and crushing of gold-bearing quartz. The alluvial deposits of the Fazogli district have been worked continuously for many centuries. It is interesting to note that of the estimated £80,000 value of gold dust exported annually from Abyssinia, besides the large quantity used in the country for ornaments, the placer deposits of the rivers in the Beni-Shangul, Tumat, and Dabus districts are said to produce three-quarters of this amount. According to Mr Malcolm Maclaren, at the beginning of 1906 £15,600 value of gold dust was received at Addis Ababa from these districts. The number of natives annually employed on the Tumat is now supposed to be about two thousand. The gold washings in this district within Sudan territory are smaller. No figures are available, but it is unlikely that more than two hundred ounces of gold dust are produced annually; all of this apparently finds its way into the hands of native jewellers. Rings of very pure gold from Fazogli are nearly always on sale in Omdurman.

The alluvial deposits of Tira-Mandi were abandoned from the time of the Mahdist revolt until two or three years ago, when it is reported that a few Nubas have restarted work at their principal deposit during the height of the rainy season. The Tira-Mandi deposits are small, and were probably never very rich.

Graphite.—Graphite is reported to exist in the Bongo River district of the Bahr-el-Ghazal Province; but no specimens have been sent in for verification. Samples of impure graphite from the Yambio-Meridi road, in the southern Bahr-el-Ghazal, have been received in Khartoum.

Gypsum and Alabaster.—Enormous quantities of this mineral exist upon the Red Sea coast, north of forty miles from Port Sudan. The beds in which the gypsum occurs form hill ranges upon the coastal plain, and the large island of Makawa is composed entirely of them. Some of the beds of gypsum are 30 feet thick, but the clearest, whitest, and purest varieties are not found in the massive beds, but in smaller ones from 2 to 10 or 12 feet thick. There are few good harbours very near the deposits save in Khor Donganab, between Ras Roweiya and the mainland; and the absence of sweet water on the coastal plain is a dis-

advantage. Gypsum has also been found at Jebel Abiad, about one hundred miles west from the Nile at Khandak.

Iron.—The iron ore deposits of the Anglo-Egyptian Sudan have been written of separately in a communication to the Geological Congress in Sweden, 1910, but a short summary may be given here.

They may be classified as follows :—

1. *Solid Deposits.*—These include any that form part of the solid geology, and are not in any way related to recent climatic conditions.

2. *Surface Deposits.*—These include any which appear to be intimately related to the existing climatic conditions, and may be further subdivided thus :

(*a*) Ores belonging to humid equatorial regions south of latitude 10° N.

(*b*) Ores belonging to the arid regions situated north of latitude 10° N.

1. *Solid Deposits.*—The Tokar district has yielded samples of massive specular iron ore ; but unfortunately the precise locality is unknown. Large masses of iron ore, iron mountains, are known to exist in the Bahr-el-Ghazal and Upper Nile provinces, but no information can be traced pointing to a recent visit and description of these places.

Among the Nubian Sandstone Series highly ferruginous beds occur. The most important hitherto found occurs near Wadi-Halfa. It is described by Captain Lyons as existing in the form of lenticular deposits, 2 to 5 miles in length, and generally of a strongly oolitic nature. A bed of highly ferriferous sandstone is reported by Dr Hume as underlying a great mass of intrusive basalt or dolerite in Jebel Alarambia near Kerma.

2. *Surface Deposits.*—(*a*) *Ores belonging to the Humid Equatorial Regions.*—In the Bahr-el-Ghazal, Mongalla, and Upper Nile provinces the rocks are generally covered by a ferruginous conglomerate associated with a lateritic formation. The rivers and streams expose it admirably, and in places between Rumbek and Mvolo, for instance, the thickness is as much as 15 metres. Usually the surface consists of red loamy soil strewn with box-shaped boulders of different sizes, and supporting a dense growth of forest and grass. In places,

however, the ferruginous conglomerate forms isolated patches of large area in the forest, so free of soil that only a scanty supply of short grass succeeds in growing. In the Bahr-el-Ghazal Province alone the iron ores cover an area of about 80,000 square kilometres, and though the thickness varies from 1 to 5 metres, it may be much more in places.

(*b*) *Ores belonging to the Arid Regions.*—The blackening of rocks is a peculiar feature of the conditions obtaining in the arid regions of the northern Sudan. It appears to be due to the action of small quantities of moisture, which bring the iron to the surface and deposit it there on evaporation. In areas formed of Nubian Sandstone this action has led to the formation of a crust seldom more than a few inches in thickness; but it is found over large areas, and may form small accumulations of nodules and fragments around hills. Many travellers have been misled by the appearance of these ferricrete crusts, and have described the rocks as volcanic. The existence of this peculiar surface action renders it difficult to distinguish the interstratified ores from the crust. It is possible, also, that some of the beds are really due to this action affecting certain parts of the sandstone more than others.

In the south and west of the Sudan the natives have for many years smelted iron, utilising charcoal, and clay furnaces about one metre high with bellows to produce a draught. The iron produced is soft, apparently of very good quality; and by barter natives all over the Sudan are partly supplied with it in the form of weapons, tools, and ornaments. The principal tribes at present engaged in smelting and smith work are the Jurs, around Mvolo; Anuaks, on the Sobat; Aliab, on the west bank of the Bahr-el-Jebel; and Bongos around the Bahr-el-Arab. The Arabs still smelt iron at Nahud in western Kordofan, and at several villages in the east of Darfur, employing a highly ferruginous clay and sand found in pockets in the red sand of the district, but formerly well-known large works, at Um Semeima and Jebel Haraza in Kordofan, have been neglected since the Mahdist revolt.

Lead.—Lead, according to the authority of Naoum Bey Shoucair, is found in Jebel Kutum or Kutub, north of Kobe,

in Darfur, but it is reported as difficult to obtain. A native of Darfur states that the deposit is now being worked.

Limestone and Marble.—Limestone and marble occur in many places, and the deposits will be described in a later bulletin. The deposit at Shercikh is the most important one now being worked.

Natron.—Natron is found in the Wadi-Natrun. The purest is found in a seam from half an inch to 2 inches thick just below the surface sand; and the best working is about 2400 yards west of Jebel Kashaf in this Wadi.

Salt.—In the arid regions many of the desert gravels are salt bearing, and particularly in the Butana, east of the Blue Nile between Rufâa and Khartoum, the natives have for many years made a living by the extraction of salt from the surface gravels. Anywhere, however, north of Khartoum salt is extracted wherever these gravels are found, and heads of impure, yellow-coloured salt of local manufacture can be found in nearly every market town. Many of the natives seem to prefer it to the purer varieties that are imported into the country. The most important localities where salt occurs in beds of considerable size are the Selima Oasis and the lagoons of the Red Sea shore; at Ras Roweiya a British company made salt for many years, and in the lagoon they employed there is now awaiting, by the process of evaporation during several years, a very large supply.

Darfur is said by the natives and many travellers to be particularly rich in minerals, but the information we have at present is unsatisfactory.

ANCIENT GOLD MINING IN THE SUDAN

Traces of ancient mining are found all over the Sudan north of the 18th parallel of latitude, and there are at least eighty-five important old workings which can with certainty be imputed to the Egyptians or the Mediæval Arabs prior to the 10th century A.D. Several attempts have been made in the past ten years to reopen some of the old workings; but owing to the difficulties of transport and the absence of water in sufficient quantities only one mine, Om Nabardi, near No. 6 Station, is at present being worked.

I am greatly indebted to Mr Arthur Llewellyn for his kind permission to utilise the report for the Egypt and Sudan Mining Syndicate, written in 1903. Additional information has been obtained principally from the works of Dr Wallis Budge, Professor Sayce, and Messrs Breasted and Weigall.

There is abundant evidence that the mining industry of ancient Egypt covered a most extensive field, and dates from a remote antiquity.

Mr Ernest A. Floyer, in a contribution to the *Journal of the Royal Asiatic Society* ("The Mines of the Northern Etbai," 1892), after a careful review of the evidence available, concludes that even before the times of the Ancient Egyptians, or in the earliest times contemporary therewith, although unknown to them, the mountains between the Nile and the Red Sea were searched and worked for gold by a people whose chief occupation was mining. It is supposed by Mr Floyer that these former inhabitants of the Etbai were a Negroid race, whose descendants dwell south of Kordofan, and worked the copper mines of Hofrat-el-Nahas.

The Phœnicians visited this ancient people to trade for the gold of the mines before Egyptian oppression had driven them further south; and for the Egyptian kings there flowed

from this source a stream of gold the volume of which, accumulated in the course of centuries, is now beyond conception, enabling them as it did to supply the civilised world.

The earliest known reference to gold appears to date from the era of Menes, the first historical ruler of Egypt, who is supposed to have reigned about the 38th century B.C. It is an enactment by which the exchange ratio between silver and gold was fixed at $2\frac{1}{2}$ to 1, thus indicating that even at that far distant date the precious metals were in common use as means of currency. Silver remained the more precious metal until about 2000 B.C.

Mr Floyer is of opinion that the first mines worked by the Egyptians themselves were in the Sinai Peninsula, and were opened under the rule of Senoferu at the close of the IIIrd or beginning of the IVth dynasty, a period contemporaneous with the building of the first pyramids.

The earliest inscriptions in the mines and quarries of Hammamat in Upper Egypt date from the Vth dynasty, a period at which ancient Egypt reached the zenith of her civilisation. This place also bears inscriptions of the VIth dynasty, and thence onward up to the Ptolemaic times.

The oldest known written record, other than rock inscriptions, dates from the XIIth dynasty (25th century B.C.), and probably refers also to the mines of Hammamat. In it a high official of the crown relates how he escorted the gold from mines between Keneh and Kosseir to Koptos on the Nile (Sayce, *Gold in Ancient Egypt*).

In the XVth-XVIth dynasties (17th century B.C.) Egypt, being conquered by the Syrian-Bedouins, was governed by a Semitic race, during which time the mines do not appear to have been worked. At the beginning of the XVIIIth dynasty, however (15th century B.C.), when Thutmosis had reconquered Nubia, the mines there had evidently been re-opened, for it is recorded that Thutmosis III was in receipt of an annual tribute therefrom of 2400 lbs. of gold (about £132,000 value). If this large figure is correct, it is at any rate certain that by 1440 B.C. the annual tribute had sunk to 600 to 800 lbs. of gold, one-third of the former amount. About 1416 B.C., Amenhotep III, in a war against the

Nubians, took away from Napata a very large store of gold in dust, figures, and ornaments.

The Turin papyrus, brought by Drovetti from Thebes, dates from the XIXth dynasty (14th century B.C.). It describes mines then existing in the Wadi Atika (now the Wadi Allagi), and is accompanied by a map, probably the oldest known cartographical effort in existence. There is little doubt that it represents the mines of Dereheib, visited and described by Linant de Bellefonds in 1868, and reopened unsuccessfully by the "Dereheib and African Syndicate" in 1902-1903. This mine is said to have been opened under King Setos I (1360 B.C.), and in 1290 B.C. we are informed of the difficulties of reaching the mine and of working it owing to the lack of water in the desert. Setos I is credited with the discovery of other mines in the Wadi Allagi, and is said to have constructed a broad road therefrom to the river Nile at Kubban, opposite Dekka. A well sunk by this king along the route was abandoned at 190 feet, having failed to discover water; but on sinking being resumed by his son, Rameses the Great, water was struck at 202 feet.

As an indication of the enormous wealth of ancient Egypt at this date, we may quote Diodorus, who states on the authority of Hecateus that a record in the tomb of Osymandyas at Thebes (supposed temp. XIXth dynasty), gives the total produce of the gold and silver mines at (? to) that time as reaching the incredible amount of 32 millions of minæ, a sum equal to 133 millions sterling.

It is supposed that the dwindling of the gold supply from the Sudan up to the reign of Setos I prompted this direct royal interest in the mines of the Wadi Allagi. At this date also the mines of the Eastern Desert, known for one thousand years, were worked systematically.

The Egyptian kings, however, prior to about 750 B.C., had not the power to take over the Sudan gold mines permanently and work them as a Government monopoly. Piankhi, the first great King of Nubia, conquered Egypt about 750 B.C., and the Nubian rule lasted until its defeat, under Tanuath-Amen, by the Assyrians about 663 or 662 B.C.

Nastasenen, King of Meroe, appears to have defeated the army of Cambyses about 520 B.C., and then raided the gold-

mining desert natives between the Nile and the Red Sea, capturing, in five expeditions, 1,252,232 cattle, about 800 lbs. troy of gold, much gold dust, and many gold figures.

The "island" of Meroe, according to Diodorus, contains mines of gold, silver, iron, and brass; precious stones and ebony trees.

With the fall of the XXth dynasty began a period of foreign domination, during which Nubia regained her independence. It would appear that not until the beginning of the Ptolemaic period (4th to 1st century B.C.) was the mining industry again prosecuted with anything like its former vigour. According to Mitchell, *Reconnaissance des Anciennes Mines de Hammamat* (Cairo, 1879), certain hieroglyphic inscriptions found in a temple at Hammamat place the date of reopening the mines under this period at about 240 B.C. in the reign of the Ptolemy Euergetes III, under whom the foreign power of Egypt reached its proudest height. The annual output of the mines under the Ptolemies is said to have reached a value of 5 millions sterling, and Strabo tells us that down to the days of the Ptolemy XIII (80 B.C.) the royal revenue was between 3 and 4 millions sterling, a great part of which no doubt must have come from the mines.

Agatharchides, Diodorus, and Strabo, who lived during the 2nd and 1st century B.C., described many of the mines very minutely, and traced their history back to the times of the early Egyptian kings; but with the advent of the Roman period of occupation (B.C. 40) all further record ceases, and the mines seem once more to have dropped into oblivion.

Towards the end of the ninth century of the Christian era, Roman rule having given place to native ascendency, the mines again received attention. Al-Makrizi tells us in his account of the Beja (Burckhardt's *Travels*), that the Etbai and Butana are full of mines of silver, copper, iron, lead, loadstone, marcasite, emeralds, "and a very brittle stone, of which if a piece is rubbed with oil, it burns like a wick."

In the reign of Ahmed Ibn-Talun, one Abderrahman El-Omari, a descendant of the Caliphs, reopened the mines at Um-Geraiat, about eighty miles from Esna on the Nile. Following this he worked mines further south at Ceija, later

still, at Jebel Essewed; and finally the more important gold mines of Dereheib. Accompanied by 100,000 men, this adventurer's career was one long record of pillage and oppression, which, after thirty years of bloodshed and treachery, ended in assassination by his own followers. History gives us no record of the result of this working of the mines; but the gold obtained must have been considerable even to admit of the maintenance of so great a number of men, the supplying of whom is said to have employed 60,000 camels bringing provisions from the Nile, and wheat from Aidab on the Red Sea.

Sir J. Gardner Wilkinson, in his learned work on the Ancient Egyptians, makes reference to Cufic inscriptions found by Mr Bonomi in the Eshuranib mines which point to their having been worked in the years 951-989 A.D. This date, if correct, brings us down to a period nearly one hundred years later than the Khalifa-el-Omari. The same writer further states, though on what authority does not appear, that the mines continued to be worked till a much later period than the 10th century A.D., and that they were finally abandoned because the amount of gold obtained barely covered the expense of work.

It is unfortunate that no records of mining by the natives are obtainable between the tenth and nineteenth centuries.

The following notes are principally in Mr Llewellyn's own words:—

The ancient method of mining the ore and extraction of gold is described in fragments of the work of Agatharchides (140 B.C.), preserved for us by Diodorus Siculus and others. It is doubtful whether the historian's description refers to the period of the Ptolemies or to an earlier epoch of the Pharaohs; but the things of which he speaks are in evidence at the old mines to-day; the iron cutters and stone mortars of the men; the mills at which the women toiled; the tables of the skilled Selangeus; the furnace of the "cook" and the pots in which he fused his gold; the slags therefrom, and even the very charcoal of his fire; all are there save the miserable wretches who wrought the task, and of them there is no tale, except the multitude of lowly mounds which mark the last resting-place of man and woman and child.

Of these people Diodorus writes: "The kings of Egypt condemn vast multitudes to the mines who are notorious criminals, prisoners of war, and persons convicted by false accusation—the victims of resentment. And not only the individuals themselves, but even whole families are doomed to this labour, with the view of punishing the guilty and profiting by their toil. The vast numbers employed are bound in fetters and compelled to work day and night without intermission, and without hope of escape; for they set over them barbarian soldiers who speak a foreign language, so that there is no possibility of conciliating them by persuasion or through familiar intercourse. No attention is paid to their persons, they have not even a piece of rag to cover themselves; and so wretched is their condition that all who witness it deplore the excessive misery they endure. No rest, no intermission from toil is given either to the sick or maimed; neither the weakness of age nor woman's infirmities are regarded; all are driven to their work with the lash, till at last, overcome with the intolerable weight of their afflictions, they die in the midst of their toil. So these unhappy creatures always expect worse to come than they endure at the present, and long for death as preferable to life."

The following is a free translation from Muller's text of Agatharchides' description: — "The metal-bearing rocks which are called gold-bearing are intensely black, but among them is produced a stone than which nothing is whiter. Of these mountains, those which are rugged and have an altogether hard nature they burn with wood; and when they are softened by fire they experiment on them, and cut the loosened stones into small pieces with an iron chisel.

"But the principal work is that of the artificer who is skilled in stones. This man shows to the diggers the track of the metal, and apportions the whole work to the needs of the wretched men in the following manner. Those whole in strength and age break the places where shines the white stone with iron-cutting hammers. They use not skill but brute force, and thus they drive in the rock many galleries, not straight but branching in all directions like the roots of a tree, wherever the stone pregnant with gold may diverge.

"These men thus, with candles bound on their foreheads, cut the rock, the white stone showing the direction for their labours. Placing their bodies in every conceivable position, they throw the fragments to the ground—not each one according to his strength, but under the eye of the overseer, who never ceases from blows. Then boys, creeping into the galleries dug by the men, collect with great labour the stones which have been broken off, and carry them out to the mouth of the mine.

"Next, from these a crowd of old and sickly men take the stone and lay it before the pounders. These are strong men of some thirty years of age, and they strenuously pound the rock with an iron pestle in mortars cut out of stone, and reduce it until the largest piece is no bigger than a pea. Then they measure out to others the pounded stone in the same quantity as they have received it.

"The next task is performed by women, who, alone or with their husbands or relations, are placed in enclosures. Several mills are placed together in a line, and standing three together at one handle, filthy and almost naked, the women lay to at the mills until the measure handed to them is completely reduced. And to every one of those who bear this lot death is preferable to life.

"Others called Selangeus (workers at the table or Serangex) take from the women the powder thus produced. These are the artificers, in whom lies the power of carrying to the end this work of royal utility. They pour the stone already milled on a table rather broad and polished with a smooth surface, which, however, does not lie flat but has a slight inclination. On this table they rub with their hands the dust mixed with water, first lightly and then with greater pressure.

"By this means the earthy particles are dissolved and flow down the slope of the table, but that which is heavy and worth anything remains on the wood. And when the Selangeus has frequently rinsed the matter out with water, he handles the dust lightly with soft thick sponges, and pressing lightly from time to time he absorbs from the table and throws away that which is soft and light, entangled in the web of the sponge.

"There remains to the Selangeus separated on the table that which is heavy and shines, and which on account of its weight is not easily moveable. This he transmits to the cooks, who, immediately they receive it by weight, put it into a clay pot, and in proportion to its quantity they add a lump of lead, some grains of salt, a little alloy of silver and lead, and barley bran.

"The pot's mouth being carefully covered and luted round, they cook it five days and five nights consecutively. On the following day, when the burnt materials are cooled, they pour them into another vase. They find none of the things which were put in together, but only a mass of molten gold, little less by weight than the original matter."

The process was somewhat rough, and it is not surprising, therefore, that a good deal of the gold obtained by means of it was anything but pure. Indeed, the inscriptions distinguish between gold ore, "gold of the balance," or marketable gold, "best gold," "gold of the second quality," and "white gold." White gold was really electrum, an alloy of gold and silver, of which considerable use was made.

Dr Beam has recently assayed some gold prepared by ancient metallurgists and finds it to be 22·3 carats fine gold; this is remarkably pure considering the method, so far as we know it, employed.

Modern investigation at the old mines of the Sudan bears out the above description substantially, but some slight alterations and further details are to be noted.

The old workings rarely reach a depth of 150 feet, and the workers seem to have preferred veins varying in thickness from 1 to 3 feet, a vein much thicker than this being rarely taken away in entirety, but followed along one or both sides. This custom was probably for the sake of safety, and in order to facilitate movement within the mine, for numerous footholds in the walls point to this as being the only means of egress; and in the absence of all large timber, ladders were probably unknown. Crude stairways were sometimes built of large stones, especially at the entrances to the workings. Here and there, where the sides are weak, "hitches" have been cut for timber props, and some of these remain to-day in an excellent state of preservation. The timber is an

acacia which is very common in the desert wadies, although of stunted growth. Tool marks are found in great numbers in the sides of the workings, and appear to have been produced by a pointed iron tool impelled by some form of hammer.

Only in one instance, at the Nabi mines, has any indication been found of the means of illumination; this consists of a portion of a broken lamp which, except for the fact that it had no handle, resembles the Roman lamp of to-day. Had these lamps been in general use in the mines, it is reasonable to suppose that a fairly large number of them would be found; in any case the smoke therefrom should be visible on the walls of the mine, especially round such niches as might be utilised for their support. But no such blackened spots are found, and the marks are absent altogether. The marked absence of smoke stains on the walls raises another point:—if, as related by Agatharchides and Diodorus, fire has been employed in the working faces as a means of breaking down the quartz, some indication of this should remain at the present day. In some of the Egyptian mines with which I am acquainted, the working faces are smeared with soot and smoke, and powdered charcoal is observable everywhere. There is also a characteristic conchoidal appearance in a "burnt" end, which is never observable in most of the working faces of the Sudan mines. Taking these things into consideration, and also the great scarcity of wood which must have prevailed then as now, it is extremely doubtful if this firing process was ever employed in this country.

Whatever the means of obtaining the quartz may have been, the subsequent treatment thereof cannot have differed greatly from the accounts given by Agatharchides. There seems, however, to have been some process of hand selection which escaped that writer's observation, for from the abundance of partially reduced quartz found in the neighbourhood of the works, it is evident that not one-half of that taken from the mines underwent the final crushing. The selective process was probably based on the occurrence of visible gold in the stone, or perhaps on some attendant phenomena of which we do not possess the secret. In any case it was efficient in result, for the rejected stone is rarely

worth more than a pennyweight or two a ton, and has never been found to contain visible gold.

The preliminary breaking down of the quartz as it left the mine was effected by stone hammers, roughly cuboidal in shape, which have become worn on every side with a slight indentation in the centre of each face. The anvil was a hard stone slab, or as often as not the less weathered surfaces of rocks, which are seen to be worn into a multitude of holes. The rubbing mills as distinguished from the grinding mills are flat pieces of the hardest rock procurable, usually dolerite or basalt, and the mullers—from 5 to 15 lbs. weight—are generally of the same material. The latter being worn on both sides, are usually lenticular, the hollow in the stone being elliptical in shape, about 20 inches by 15 inches, and often as much as 4 inches deep. Frequently the stone has been turned, and a similar hollow worn on the other side until both have met.

The circular grinding mills are from 18 to 22 inches in diameter, the nether stone being also of exceedingly hard rock. The mullers, which are pivoted in the centre, are usually of a softer material, a coarse-grained granite being the favourite, and the original weight would be about 50 or 60 lbs. The quartz was fed through a hole in the upper stone, and rotation was affected by means of a short stick inserted in a shallow notch. Some of these mills are worn to a depth of 8 or 10 inches, and like the elliptical ones, many of them have been turned and used on the reverse side. It is a curious fact that very few of these nether stones remain intact. When not worn through they have in nearly every case been broken at the side, and this must of necessity have been intentional. The assumption is that when the former workers left the mines, these things being too heavy to remove, were purposely destroyed to prevent their use by others. The upper stones in many cases they appear to have carried with them, for these, besides being lighter, entailed more work in preparation.

The washing tables measure about 9 feet by 2 feet 6 inches, and are built of undressed stone with rubble filling. The upper surface was plastered smooth, and sloped at an angle of $1\frac{1}{2}$ inches to the foot. As the table was usually

built on ground which sloped in an opposite direction, the head of the table would stand about 2 feet 6 inches above the ground. A circular stone-lined cistern, 4 or 5 feet diameter, at the bottom of the table, served to catch the water which flowed therefrom, and this returned by a narrow stone-lined channel to a similar cistern immediately below the head of the table, whence it was raised by the operator with the aid of a small "shadoof," to be used on the table again. The sand or tailings collected in the first cistern was thrown out to form large heaps, many of which remain to the present day. A small rectangular stone-lined pit is usually found alongside each table, and it is surmised that this was for the reception of the pulverised quartz as it came from the mills.

The presence of the broken melting-pots and quantities of scoriaceous slag confirms the description of the means employed for the ultimate separation of the gold from the baser metals; and that this process was a most effectual one, may be inferred from the fact that no trace of gold can now be obtained from the slags. Mercury does not seem to have been known to the workers, or, if known, was evidently not employed as a metallurgical reagent.

Probably most of the final extraction of the gold from the crushed ore and the smelting was performed on the river banks, for both at Dafoufah near Kerma, Kawa opposite Dongola el Ordi, and at Meroe, enormous mounds of broken crucibles and slag have been discovered near the sites of important ancient towns.

Not the least interesting feature of these ancient camps are the hut remains, of which great numbers are found at every important mining centre. The walls usually consist of a single thickness of undressed stones, supported by smaller fragments wedged into the crevices; but here and there a building may be seen where the wall is formed by two facings and a rubble filling; plaster of any sort being quite unknown. The height of the walls varies from 2 to 5 feet, and the average may be taken as 3 feet above the ground. The plan as a rule is roughly circular, 8 to 10 feet diameter within, with no opening but the entrance, which is sometimes surmounted by a lintel, although this is very

rare. No roof structure has been seen, and the former covering was probably some kind of mat or woven material. At most of the mining centres the huts are scattered indiscriminately along the edges of the wadies, or at points convenient to the works, but in others they are found arranged in compact blocks. This may possibly have been with a view to mutual protection and defence; but if, as Diodorus informs us, the Ptolemaic mines were worked by slaves, some form of supervision would be necessary in the camp no less than in the mine, and it would be obviously impossible to exercise this in a widely scattered camp. The suggested inference is that these rectangular walls and close encampments may mark the scene of Ptolemaic and earlier work, whilst the scattered huts and isolated mills date from the period of Arabian occupation.

Ancient wells probably exist at many of the mining sites, for it is difficult to believe that the workers brought their water from such great distances, as most of the present wells are removed from the mines. These wells would naturally be situated in low-lying ground, thus facilitating their obliteration by blown sand and by occasional rainstorms. The burying-places pertaining to the mines are usually situated in a wadi-bed, in close proximity to the scene of work. The graves are irregularly scattered, but have almost invariably a general orientation north and south. They are from 4 to 5 feet deep, and the body lies, with the feet towards the north, between two narrow ledges which support a bridge of stone protecting it from the superincumbent earth. At the top there is usually a ring of stones encircling the grave, with an upright stone at the head and at the foot. The space within the ring is often covered with small stones, which are sometimes selected white quartz or rounded pebbles from the wadi-bed. The form of sepulture, and the fact that where human remains have been found, the skull is invariably of a Semitic and not Negroid type, points to these being Mahommedan. The unfortunate workers of earlier days were probably so carelessly buried that nothing now marks their graves.

A great number of potsherds of various shapes are found in the neighbourhood of the mines; all are of common

unglazed earthenware and usually of a brick-red colour. Various other articles have been found, but nearly all are remnants of the Arab occupation. They include:—a short pointed iron tool, pierced for a haft, and corresponding to the modern single-pointed pick; a broad hoe with the eye attached by rivets; iron wedges; packing needles; a pair of scissors; brass scale-pans pierced with holes for cord supports; some small copper ingots which may have been weights; portions of large bronze vessels, probably cooking-pots, but extremely thin and bearing evidence of skilful manufacture; fragments of coarsely woven cloth; fragments of seashells and ostrich eggs, probably used for the reception of gold dust; some beads and small articles of personal adornment; a small stone tablet inscribed with the emblem of the sun-god Horus; and numerous fragments of broken glass commonly of a bright greenish-blue colour. Unlike the mines of the Eastern Desert of Upper Egypt, hieroglyphic inscriptions appear to be entirely absent; so far as I am aware, the only inscriptions discovered in the vicinity of the Sudan mines are Cufic, dating from the 9th and 10th centuries A.D.

EXTRACTS FROM BERGRATH RUSSEGGER'S *TRAVELS IN THE SUDAN*[1]

Translated by CHARLES TUCHMANN, a Director of the London and Sudan Development Syndicate.

Where possible the names of places have been altered in accordance with the present spelling.—S. C. D.

"Russegger's name, if little known in England, is honoured by all scientific men on the Continent.

"Mining councillor in Austria, he was sent out in 1835 to Egypt by the Austrian Government (under Prince Metternich and Prince Von Lobkowitz), at the request of Mohammed Ali. The revenues of the Khedive were at the lowest ebb: he was firmly persuaded of, and acquainted with, the existence of gold in the Sudan: and he petitioned the Austrian Government to despatch some mining experts to survey the country, and assist him in replenishing his depleted exchequer. Russegger was accordingly appointed chief of an expedition, which Prince Metternich equipped in a generous spirit, with the best scientific instruments and general outfit needed at that time for a first-class survey. Exceptional facilities of every kind were also afforded by the Khedive, including an escort of over a thousand soldiers.

"Russegger's first expedition was confined to lower Egypt. His second expedition started from Khartoum in October 1838, and went up the Blue Nile, through the Fazogli and Beni-Shangul districts to the borders of the Galla people, and returned to Khartoum by the same route."

VOLUME XI., *pages* 755-757.

"On glancing back at the gold-bearing district traversed, whose first indications were met at Roseires, the thing that

[1] Russegger, J., *Reisen in Europa, Asien, und Afrika*, Stuttgart, 1841-9.

strikes one is its vast territorial extent. Reckoning only the area of the gold-washings and mountainous formations, which must be reckoned as auriferous (in so far as I became acquainted with them from personal observation, or from trustworthy native sources), this must be at least 4800 English geographical square miles. Considering further that there are gold-washings on almost all the western hills, along khors Dul, Keili, the Tabi (rivers draining those hills), and so on, and that gold is known to exist in the rock in certain localities, *e.g.*, on the Dul; that the gold-washings on the right bank of the Blue Nile must extend far into the Abyssinian hill country, and that their limits on the south towards the Galla country are quite unknown; and reckoning further, the gold-bearing region to the south and south-east of El-Obeid, in the Tagali, Tira-Mandi, Sheibun, etc., I believe that apart from a presumable recurrence of the gold-bearing formations south of Darfur, the area of the auriferous territory of the Sudan may certainly be reckoned as at least 24,000 English geographical square miles."

"If we consider the gold capacity of the region from a geological point of view, we obtain the following capital data:—

"1. There is an enormous wealth of gold in the interior of Africa (*i.e.*, the Sudan) within the matrix of the primitive rock, and in the alluvia of the streams and rivers.

"2. The gold is found pure in grains which are seldom of mathematical dimensions, and are native to the granite-gneiss and gneiss-chlorite-schist formations. In the former the gold appears in the veins of quartz, calcite, and felspar, both pure and also mixed with zinc sulphide, iron oxide, and iron pyrites. In the latter formation it appears in great massive layers of quartz, along with brown hematite, magnetite, clay-ironstone, and iron pyrites.

"Of the auriferous strata of the alluvia, in which the gold is found along with magnetite (gneiss chlorite—slate formation) and pyrites (granite-gneiss formation) those are the richest which are composed either of a loamy, iron-ochre mass, mixed with stones and detritus, or of firm, stiff clay, mixed with sand or vegetable remains.

"4. The alluvia of the wild, rocky mountain torrents where the water during the rains is in a perpetual state of turmoil are, as a rule, more richly auriferous than those with a gentler flow.

"5. The richest alluvia I found were those in Khors Adi, Akontosch,[1] Khor Dahab, Khor Gutschesch, and on the upper Tumat. The yield of the Abgulgi was very uneven.

"6. The yield of the streams flowing from the east and opening into the Tumat were conspicuously richer in gold than those of the western bank.

"7. With few exceptions the gold is of extremely high quality. As shown by average tests, the Adi gold was the finest—22·8 carats; that of the Abgulgi the lowest—20·6 carats."

VOLUME X., *pages* 537 *et seq.*

"The gold-yielding region extends from the Abyssinian Mountains on the east of the Blue Nile; westwards to the vast unknown plains between this river and the White Nile; northwards to Jebel el Geri; and southwards as far as the plains of the Gallas, south of Fadassi. There can be no doubt that the gold-bearing alluvium of the rivers and gullies of that district is even more widely distributed. The best known and to some extent the most important of the gold-washings which the Negroes have carried on from time immemorial within the above limits are:—Jebel el Geri, Fazogli, Adassi, Fabindo, Dulu, Fadokha, Faronge, Fallabut, Fassankaru, Gassan, Abi, the Ghomasha district, Gennaghazza district (called by Russegger 'Beschori plateau, auriferous gullies of Pulchidia, Gutschesh, etc.'), Jebel Gumgum, Khor Karuri, Jebels Diss, Dul, Beldoesu, Soda district, Gamella, Abul Dugu, Kukulik, Jerok, and Keili." (Sixteen other places are named, not to be found on his own or modern maps.)

"Gold is also found in the mountains near Fadassi, while iron ore is extracted in the surrounding plains, at an inconsiderable depth from the surface, and from the description must be identical with the bog iron ore (? laterite)

[1] Khors Akontosch, Gutshesch, and Abgulgi are not marked on the maps, but are apparently streams in the Gennaghazza district.

we encountered in Kordofan. The Gallas, who possess large herds of cattle and a multitude of small but sturdy horses, work this ore into iron as in Kordofan, and also melt the gold into rings, etc. So far I have quoted my guide, Sheikh Mohamed, on this matter. I myself became acquainted with these, and many other gold-washings not named by the Sheikh; in other instances I saw enough of the locality to enter them on my map. There were only a few which I was unable to locate with certainty."

Under the title of "Eldorado," Russegger then describes with detail and extravagant optimism the gold-washings of the Negroes situated in the Beni-Shangul and Asosa districts between Khor Tumat and Khor Yabus and the Blue Nile. According to him, this district known to the Arabs as Dar-el-Burta and designated by Cailliaud Dar-el-Bertat and D'Jebel-D'Ouyn "is better written Dar-el-Pert, the 'cold land' (which name comprises the high mountain district of the upper Tumat); and Dar-el-Djebel-D'Ouyn is Dar-el-Dschebelaiun, literally the 'land of the mountain people'!"

Russegger did not visit Jebel Dul as the natives there were hostile, but he gives the following description :—

"According to the inhabitants of the Sudan, Jebel Dul (lat. 10° 29′, long. 34° 25′), which no white man had ever visited, must from its wealth of gold be a veritable Eldorado. Among the natives of the Dul range and neighbouring mountains are many Dongolawi, who were partly traders and carried on the gold trade in particular. These Dongolawi were much looked up to by the Negroes, and propagated a knowledge of Arabic, protecting all travellers others than white men. By all accounts Jebel Dul is the richest gold-bearing district in the entire tract of country between the two great rivers. The alluvium of every ravine contains gold, certain clay strata (as was also noticed on the journey through the high plains at Beschori, about latitude 10° 35′, longitude 34° 50′) being especially rich. These strata crop up at different depths below the surface. Gold also occurs in the projecting rocks, and I was presented with one lump of granular blackish-grey quartz, which exhibited earthy

magnetic iron upon its facets, and was so richly sprinkled with pure gold that I estimated the auriferous content of one hundredweight of such quartz to be at least sixty loths (90 carats = 11·9 dwts.). This lump was found in a sack in a native hut at Beni-Shangul by a Sheikh who presented it to me, and both my guides subsequently affirmed that it comes from Jebel Dul, where it occurs apparently as a vein in the gneiss, and that the Negroes endeavour as far as possible to work the rock. After pounding it up, they partly wash it out like the loam and rubble of the gullies, partly, however, as regards the best pieces, content themselves with smashing them up, blowing away the powdered stone by the mouth, and melting the residue of gold into rings. These manipulations are carried on exclusively by the women."

Russegger discovered gold-washings in the two gorges of the Khor Abenurri which open on the Tumat and at other places in the Beschori district (about latitude 10° 35′, longitude 34° 50′). The alluvial deposits in the Abgulgi (? Abenurri) also proved very rich in gold, but nothing was discovered of the quarries, in which, according to Cailliaud, the Negroes dig out the gold-bearing strata. Russegger ascribes this to his ignorance of the precise locality, as many similar diggings were subsequently found at Fasankaru. Khor-el-Dahab (either Khor Amora or Khor Sumba, draining Jebel Faronge) is, as its name implies, remarkably rich in gold. In Khor Odi Russegger saw a number of shafts close together on either side, by which the Negroes pierce the rubble to a depth of over 20 feet to get at the underlying auriferous strata. Pure gold was also found in the quartz blocks of the detritus.

VOLUME XI., *pages* 709-724.

"West of Sennar are two groups of mountains known as Segadi and Moya. In approaching Segadi from Sennar a number of solitary rocks crop out, obviously the crest of a great vein, which can be followed for a considerable distance. The mass of this vein consists of a peculiar, variegated, extremely hard rock resembling hornblende, permeated with

iron oxide, with brown hematite in the fissures. There is a considerable admixture of quartz in the rock, partly crystalline, partly in irregular nodules which produce a porphyry-like appearance. In places the stone is full of small, cellular spaces, passing at the surface into a porous ragged quartz. In the cellular spaces are some remarkable mineral bodies consisting of microscopical black crystals (which Russegger does not presume to identify, but which the translator suggests may be diamonds!) Some pyrites is scattered at intervals and point to the presence of ore, but this was left undetermined. The vein reappears to the south-west in the clay-schist of the little hills between Segadi and Moya, leaving no doubt as to the nature of its formation. This clay-schist is black or darkish grey, has a marked silky gloss, and contains iron oxide between its strata. Parts of it are quartz, with mica in large and distinct quantities alternating with the quartz, *i.e.*, the clay-schist passes into mica-schist, producing undulated lines in the strata. On the broken surfaces of the rock there is a considerable deposit of graphite.

"An hour and a half from Segadi is the little hill of Gara, the southern spur of Segadi, and like it belonging to the chlorite schist, distinguished by a considerable exudation of iron oxide between the strata. The ridge of the hill is formed by a large vein of quartz, which is dense and glassy, as clear and pure as water. Many of the strata exhibit scattered iron pyrites and arsenical pyrites. The latter are partly crystallised; the former entirely fused into the quartz mass, or distinct as little hair-like, branching particles almost indistinguishable from certain forms of brittle and hexahedric silver-glance. In all probability these pyrites are auriferous. In addition to these ores the quartz contains pure sulphur in minute crystals of a deep yellow colour, which give rise to a strong sulphurous smell when the rock is broken up.

"Turning south again towards Roseires, comes Mount Krduss (Jebel Kardos and Okalma), 800 feet high, composed of granular quartz, perhaps of the gneiss formation. This quartz is full of mica and red tourmaline, with numerous fissures, equally of granular quartz, but quite distinct in

character from the adjacent rock. The quartz of these fissures is extremely loose in texture, very porous, clear and colourless, while the adjacent rock is of a dull reddish-grey. The quartz of the fissures is ore-bearing. It contains copper pyrites, copper azure (carbonate), and grey copper ore; some in separate crystals, some fused into the quartz. Portions of its quartz are rich in iron, and if the rock is split there is considerable exudation of red iron oxide.

"Near the opening of the Tschamus (Khor Magansa) into the Blue Nile, Jebel Maba (on the opposite side of the river) rises to a height of 400 feet above the plain. Gneiss appears at its foot with local transitions into porphyry-like granite, rich in hornblende. From this the predominating formation of the district, rises Jebel Maba, in a strange mass of highly ferruginous hornstone and hornstone porphyry, with vitreous felspar, hyalite and opaline quartz. The former gives a trachytic character to the rock, while the quartz is discontinuous, and the hyalite, in little dark, reniform particles, adheres to the walls of numerous bladder-like sacculi. A section of these saccules always shows a torn, jagged edge. They are often filled wholly or partially with brown hæmatite and argillaceous ironstone, both of which, moreover, form the filling of the several veins and fissures. Apparently there is here no obvious stratification. The ironstone veins are simply the dividing fissures filled with iron ore. These ironstone lodes, more especially those which are filled with argillaceous ironstone, are several feet in depth. The argillaceous ore is of the yellow variety, often crumbled to ochre, and seems to be very rich in quality, containing 50 per cent. of iron.

"In one of the deeper argillaceous veins was a partially filled cavity. It appeared to be of natural origin, an open fissure, but had evidently been worked at some time along the strike of the vein to the south-west. Probably at some remote period the natives had appreciated the value of this easily obtainable and easily smelted ore, treating it by the same methods as those applied to the bog-iron ore of Kordofan. Should these ores ever be worked, it would be advisable to set up the smelting works on the left bank of the Blue Nile, where there is fuel sufficient for

a small plant, and where the river might perhaps be used as driving power.

"Following the left bank of the Blue Nile from Khor Magansa southward there is an unbroken alluvium. The detritus of Khor Ofat, which, like the Magansa comes down from the Tabi hills, consists chiefly of pure quartz sand, and at "Hoeli-Hoeli" (somewhere near the present site of the Slavery Post, a few miles from the mouth of the khor) Melek Soliman employed some two hundred of his people yearly in washing the gold out of the deposits of the khor.

"The mountains of Fazogli belong to the gneiss formation, and chlorite-slate predominates. This range lies between the Tumat and the Blue Nile rivers, and the sand of the Tumat, consisting of quartz, chlorite-slate, and magnetite, is gold-bearing. The Fazogli negroes annually do a little washing here, but not to the same extent as in more southern localities. They are much more expert than the Nubians (? Nubas of Tira-Mandi). Wooden troughs, 1 foot 5 inches to 2 feet in length by 1 foot in breadth, well made, and not more than 3 inches deep in the middle, closely resembling the washing pans of our miners, are employed. The sand, etc., is thrown into these troughs, under constantly running water, shaken, the stones thrown out, and the "dead slick" collected from the surface with the hand. A fairly unalloyed magnetic iron slick remains, which is then treated for the actual extraction of gold. This is performed in the same troughs, the Negroes skilfully setting the water in motion with a constantly rotating movement. The gold collects in the centre of the rotatory circle, and the dead slick can be removed from the edge by hand. The process is repeated till the gold is as pure as it can be got, when it is removed with a rag, and laid on a mussel-shell, as the Nubas do at Tira-Mandi. For melting down the gold they employ little clay pans, made by themselves. The Negroes have an ingenious method of precipitating the fine particles of gold that float on the surface of the water (the "float-gold" of European washings). They scatter ashes on the water, when the "float-gold" at once sinks to the bottom."

The magnetite of the river-sand is characteristic not only of this deposit but also of the rock formation of the chlorite-slate, whence they are both derived. The gold is here native to this formation, and Russegger believes it to be distributed in the pure slate throughout the entire mass of the chlorite-slate, like the magnetite, and not merely deposited in certain localities. The alluvial deposits that surround the hills are the result of their disintegration, and so long as that process goes on will the formation of the alluvium continue. The rivers perform a process of washing and purifying, so that the gold is more particularly found in spots where the ripples have washed the sand into hollows between the rocks, or roots of trees, or at any sharp angle of the banks of the stream.

"Along the Adi the Negroes work by shafts pierced irregularly and quite close together. They are some 2 to 3 feet in diameter, and vary in depth. In the actual bed of the khor the natives do not go below 3 to 10 feet. Should they happen on a good auriferous stratum they work it as far as possible from this shaft, producing a number of very low spaces and irregular little workings. The only tool used is a small pointed stick of very hard wood. The lack of picks, spades, and shovels is supplied by the hand.

"On the right bank, where the upper earth is often 6 feet deep, the shafts have to be longer, even 18 or 20 feet, to reach the bed of the river below. The auriferous loam dug out is stained red from iron oxide; it is intermixed with quartz debris and is plastic. Breathing in these shafts appeared to be very difficult.

"The Negroes have never sunk shafts to the bottom of these gold-bearing strata on account of the water, but they probably reach to within 6 or 8 feet of the solid ground, so that the depth of the auriferous clay would be about 18 to 24 feet. The gold thus obtained is remarkably fine and pure, as shown by the size and brilliancy of the nuggets."

Pages 746 and 747 describe a method adopted by the Negroes for obtaining gold from the poorer rubble. This consists in washing the mud by artificial canals into pits,

when the swirl of the water makes a partial sifting of the mass, which is then treated in the washing troughs, as above.

RUSSEGGER'S EXPEDITION TO KORDOFAN, VOLUME IX., *pages* 200 *et seq.*

"The bed of every stream in the vicinity of Jebel Sheibun and Tira, near Jebel Dahab, and further southwards toward Tungur and beyond, exhibits a gold-bearing alluvium. Every year at the close of the rainy season, when the fury of the torrents has abated a little, but water is still plentiful in the holes, the natives of the whole district begin to wash the gold out of this alluvium. A band of Tira negroes came to conduct us to the gold-washings. We passed the beds of several streams, coming down from the Tira mountains, which the natives pointed out as gold-bearing. We investigated the several alluvia, saw traces everywhere of previous workings, and everywhere came on gold. At the same time we were convinced that we were not shown the localities where lay the richest alluvium; as is perfectly intelligible, seeing that the superior officers of Kordofan, who engage in the gold trade at considerable profit, would be unwilling to let the Egyptian Government lay its hand upon their gold harvest. Everyone was obviously concerned in hindering us from making extended observations."

Russegger says that all the Negroes wear heavy gold rings in their ears and noses. He confirms the observations of Denham, Clapperton, Oudney, and others in regard to Darfur, describing it as a vast grassy and wooded plain, with no gold or silver but an abundance of iron and copper. He says that the deposits of the numerous torrents that rush down from the mountains in the rainy season either towards El Obeid or Lake Keilak, or lose themselves in the western plains, contain more or less gold.

"Mount Sheibun, which rises solitary from the low hill country that extends to the foot of the Tira range, is in the main composed of gneiss of a granular, slaty texture, with white felspar, white quartz, black and dark green mica, and

traces of magnetic iron; the same rock, in fact, that one sees in the valleys of Gostein and Rauris in the Austrian Tyrol. The alluvium in the immediate vicinity of Sheibun has this special feature; in the grooves where it is washed bare by the rain, exposing the gneiss it rests on, the upper layer consists of black greasy earth, next to which is a blue plastic clay with recent vegetable detritus. This clay is very dense in places, hard, and gold-bearing. No traces of shafts and trenches were found as in Fazogli; but the natives evidently did their best to keep the matter secret."

"The Nubas wash gold in this district every year. They stated that in many of the best localities of Tira one man may, if very fortunate, obtain as much as 15 shillings worth of gold a day, and in the more ordinary spots the washers may, on an average, obtain a value of six to eight shillings per diem." Russegger admits that he saw no alluvium in the Tira that would justify these estimates, but his visit was brief and interrupted by the rainy season and the timidity of his escort. He convinced himself, however, "That gold exists everywhere in that alluvium and even in the black earth; that the gold-bearing alluvium extends over the whole of the hilly plateau (several square miles) between Tira and Tungur, as well as beneath the southern and the western mountains of Tagali, and that since the Turks have been in possession of Kordofan (written 1837), the constant and extensive yield of the gold-washings obtained, both from the Negroes, and from the plunder by the Defterdar of the ancient treasures of Kordofan, has amounted to the value of many million dollars exported to Egypt, not accounting for the gold that has remained in the hands of the Sultan of Tagali." The market for Nuba gold was then exclusively in Kordofan, where the buyers took all help from the uncertain rate of exchange to advance their own interests.

"Copper comes from the mines of Hofrat-el-Nahas, lying south of Darfur, about the 10th degree of the northern latitude, and is sent as an article of commerce to Darfur, and thence in the main to Kordofan. Browne saw it in the form of great rings, each weighing 10 to 12 pounds. What I, on the contrary, obtained from the merchants of Kordofan

THE GOLD-WASHINGS AT TIRA-MANDI, CENTRAL KORDOFAN.

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was in the shape of small granules, doubtless the original form in which the copper comes from the workings, which, according to the description of the natives, resembles the process employed in Kordofan for iron. This copper is of a light yellowish colour, extremely fine and pliable, and so pure that I was unable by any reagent to detect traces of any other metal in it." Russegger tried in vain to obtain specimens of the ore that contains the copper. "The natives asserted that it was found in a pure state, as such, immediately beneath the surface, so that it was worked with very little trouble. Under such conditions it would be easy to accept the production of the pure metal by native processes, a thing that would otherwise be almost incredible."

PROSPECTORS' REPORTS

DONGOLA CONCESSION

Executrix of W. T. Preston, Esq., Nile Valley, Block E.

Prospected by Mr G. R. CAREY, for Messrs Lake & Currie, Mining Engineers, in the winter season 1903-1904.

Geology.—" Out of the 28,000 square miles of the Concession some 25,000 are undisturbed sedimentary beds. These consist of coarse sandstones, grits, and conglomerates, with occasional gritty chalks, below which, in the southern half of the Concession are finer sandstones, clays, and clay iron stones, marked by an abundance of ferruginous matter and fossils of plant roots. In those at Dongola layers of carbonaceous matter have been found, indicating a possibility of coal below.

" Underlying the sedimentary formation is a metamorphic complex of granites and other holocrystalline rocks, with gneisses, slates, schists, and intrusive diorites, basalts, etc.

" These are exposed along the river valley almost throughout the northern half of the Concession, and in three districts in the southern half, the first around J. Alibarsi, the second at J. El Hush, and the third in the S.W. corner of the Concession around J. Razal.

" At the Halfa Cataract, where the crystalline rocks first appear, and as far south as Semna, there are principally holocrystalline rocks. Patches of well-cleaved slates appear principally in the northern part of Murshid, around J. Debba, a few miles north of Sarras, and again south of Sarras. The strike is N. 20° E. to due N., and the dip almost vertical, inclining slightly towards the west." " Quartz outcrops are plentiful, but so far as sampled, do not carry gold, and have been left alone by the Ancients."

"At Semna, extending with occasional interruptions as far as the Kulba Hills, exists a formation consisting of metamorphic beds of sedimentary origin, which, though having been but slightly displaced, have acquired crystalline structure and a well-marked cleavage parallel to the bedding. These lie on a granite base, which in many places has also been altered and acquired gneissic structure, with laminations conformable to the superincumbent beds. The strike and dip of the cleavage varies considerably, but strike of N. 25° W. and a dip of 20° to 30° towards the S.W., is about the average. This formation is most marked in the bend of the river between Semna and Askor, and again between Okma and Kulba. It is also seen in the Babat Hills and around Ambugol, while on the other side of the river it is very strongly marked, covering large areas, and forming the great mountain ranges of the Atiri and Maraheg.

"West of this formation is a belt of granite, beyond which again is the sandstone, and along the river, from Melik en Nasar to Alimula, there is also granite. Occasional schists and quartz diorite intrusions also occur in this section.

"In the neighbourhood of Kulba quartz outcrops are frequent, some of which are strong reefs, and with one exception have been worked by the Ancients.

"South of Kulba as far as Dal the formation is all granite, but southwards again to Kosha there is a belt of well-defined slates flanked for some distance by granite ridges along the river side. These slates strike north and south, and dip fairly steeply towards the west.

"Southwards from Kosha patches of metamorphic rocks are exposed in the lower part of the river valley, the most prominent being at Hamid. In the Dalgo district, from Sulb, the rocks are very regular and well laminated, the slates striking N. 10° E. to N. 15° E., and dipping steeply towards the east.

"In the southern parts of the district the slates form mountain ranges often capped with sandstone. Quartz diorites and other igneous rocks occur at one or two points, but are most marked near the river, a little east of Tinari.

"In the Alibarsi district, separated by a few miles of sandstone from the Dalgo district, the crystalline rocks first

appear as slates, evidently continuous with those of the Dalgo district: a heavy fault cuts these off against granite in a line of hills called J. Norh. This granite extends over the rest of the area, except for occasional intermissions where it is overlain by sandstone.

"The Hush is merely a group of basaltic hills protruding through the sandstone.

"Jebel Razal is an outcrop of granite."

Ancient Workings for Gold.—*Murshee.*—An open cut, now filled in completely by sand, running intermittently for about 200 feet almost east and west through a syenite country, on which some slightly altered conglomerate lies. The width of the vein probably did not exceed 3 feet, while the dip is steep and probably towards the north.

Ambugol.—Surface workings covering an area about 300 × 100 yards, running east and west, possibly on small veins traversing metamorphic country of cleaved rocks.

Akasha.—An open cut, now filled with debris, about 150 feet long and 3 to 4 feet wide. Fair-sized dumps and ruins of ancient huts exist here.

Hamid.—Close to the river, a strip of slate for a length of 2 miles has been worked over. Very possibly not for gold; but the natives of the last century only worked the slate for the lime it contained, to improve the soil cultivated along the river.

Agula.—A small old working is reported by the natives in the hills west of Agula or Sulb.

Tinari.—The old workings here exist in three groups. Mining (prospecting) operations were conducted by the company, but unsuccessfully.

The main workings have a total run of 325 feet, and the vein was about 2 feet wide. From the fact that the stopes had been filled in with broken quartz, Mr Carey assumed that only a small portion of the quartz carried gold of sufficient value to be worth crushing.

The second working lies about one mile south-east from the main working, and is about 150 feet long. The third working consists of a trench 100 feet long and 10 feet wide on apparently poor quartz, and is about one mile south of the second working.

Tondi.—On the opposite side of the river from the large ancient workings of Abusari, consists only of surface scratchings upon small veins.

Tonduli—A little east of Jebel Tonduli in the south-east of the Dalgo District. Surface scratchings on small veins traversing slate country.

In several parts of Dalgo district the whole surface has practically been worked over; at a time when very low values were profitable.

Traces of gold were found in some gravel heaps, which had been worked by the ancients, at Aduan near Adbur Island.

Mineral Prospects other than Ancient Workings.—1. The many strong outcrops of quartz, particularly in the Akasha, Kulba, and Dalgo districts, which may contain gold, but so far as sampled proved of no value.

Lignite was discovered by Bimbashi Hodgson in 1903 at Dongola, about 30 feet below the surface, in the form of a carbonaceous bed of whitish clayey sandstone about 4 inches thick; boring failed to discover any beds in depth worth working.

Salt occurs in abundance at Selima Oasis, and is of excellent quality. Near Dosha also; but of poor quality and of no commercial value.

Iron occurs abundantly in the sedimentary area, but the situation of the deposits renders them valueless.

Hot Mineral Springs occur at Akasha, and are held in great repute by the natives. "They contain considerable quantities of chloride and sulphate of soda, as occur in the waters of Carlsbad."

The Prospecting License for this Concession expired on 30th September 1906.

EGYPTIAN AND SUDAN MINING SYNDICATE, LTD.

Prospected by Mr ARTHUR LLEWELLYN between 11th January and 20th May 1904.

Geology.—"A basal formation of grey granite, sometimes micaceous and sometimes hornblendic, but composed chiefly of coarsely crystalline felspar, and weathering in characteristic whaleback hills and exfoliating boulders. This sometimes rises into high hills, as at Shakrieb and Mulka, but more usually underlies a clean, white, gravelly plain with detached outcrops of rounded boulders. The granite is usually more or less gneissose in structure, which becomes more marked towards the boundaries of the formation, and over certain areas where it is supposed denudation has not been so deep. At these places the rock would certainly be classed as gneiss, although at no spot seen was there conclusive evidence that it was a separate formation, except by gradual transition from the parent granite.

"Overlying this granitic gneiss, but sometimes uncomformably, is a series of metamorphic sedimentary rocks, which in the absence of all fossils will probably be classed with the Archæan. They consist of conglomerates, clay-slates, micaceous and talcose schists, gneiss and crystalline limestone. Overlying these rocks again, but separated by, apparently, an enormous break in geological time, are small areas of sandstone, etc., remnants of the vast formation of Nubian sandstone extending southwards into the Sudan.

"Associated with the metamorphic rocks, intruded through them, and at places apparently outspread upon them, are a series of basic igneous rocks. They include typical crystalline diorite, gabbro, diabase, aphanite, and andesite. Many of the smaller exposures are porphyritic in structure, with crystals of white felspar which, in the same mass, become less and less distinct in crystalline form until the felspar appears as ill-defined blebs in a matrix differing little in colour, and apparently in composition, from itself.

Whether or not these rocks are contemporaneous with the metamorphic schists it is difficult to decide.

"Among the high hill ranges the central zone consists often of a characteristic red granite, syenitic in character, which appears to be a rock intrusive into the grey gneissose granite; in fact it is an open question whether it is not more recent than the metamorphic schists. Many of the acidic dykes which traverse the latter can be traced into the red granitic zones where they cease to exist as such—indicating either that they lose their identity in the parent mass or, like the schists in which they occur, have been displaced by an intrusion of more recent rock."

On Mograt Island at Abu Hamed, agates and fossiliferous flints, the fossils being chiefly crinoids and gasteropoda, occur abundantly in the alluvial soil.

Proceeding south between Abu Hamed and Abu Hashim, on the east bank of the river, the rocks are at first gneissic, striking a little west of south and dipping west, overlaid with patches of limestone—white, blue, buff, and variegated; these gave place to schists and shales mostly micaceous, and these in turn to sandstone, which appeared to be much more recent, although earlier than the Nubian sandstone. The sandstone consisted of red felspar and transparent quartz grains, with a development of mica in the interstices. It is earlier than the fossiliferous pebbles of the river found on Mograt Island, as one such pebble was found with sandstone as a nucleus. The rocks at Abu Hashim are bluish-grey micaceous and chloritic schists, striking north and south and dipping west; they are traversed by numerous quartz veins. For 25 miles south of Abu Hashim the geological formation is of the same Archæan character, gneiss alternating with schists and quartzites.

At the mouth of the Wadi Hashim huge pegmatite veins are seen traversing the schists in all directions, the outcrop in some cases standing 40 feet above the surface. Ten miles south of Abu Hashim is a tremendous boulder outcrop of black igneous rock, probably dolerite. Near the Wadi Shereik a band of coarsely crystalline limestone is being worked, for lime-burning.

Ten miles south of Shereik there is a broad area of

diorite, further south the rock possesses a schistose structure and consists almost entirely of pink felspar blebs in an almost black, hornblendic magma. Between Khor Um Oshara and Berber, the rock, where exposed, is a finely laminated clayslate with numerous parallel and continuous bands of fine quartzite. The strike is parallel to the river course (S.S.E.), and the dip about 60° W. Around Abidia the rock is gneiss, almost entirely concealed by pebble beds.

Jebel Sotriba, 35 miles north-east of Berber, is of volcanic origin; the rock consisting chiefly of pink felspar and finely crystallised hornblende, but the central space of a more basic rock with semivitreous masses of various colours containing amygdals of a chalcedonic character. Between Sotriba and the wells of Obak a hill of brecciated conglomerate, consisting of quartz fragments in an ochreous matrix, lies 10 miles east of Sotriba, and again east of this outcrops of blue slaty limestone and 2 miles further on, a band of talcose schist containing small areas of almost pure steatite, which have been worked on a small scale, probably for fashioning into cooking-pots.

Jebel Shakrib is a huge boss of old grey gneissose granite, with scarcely any talus. Along the east side of the hill is a small synclinal of crystalline schists; westward is a continuation of the sandy plain with occasional exposures of gneissose granite in exfoliating boulders. The hills of Sul Hamed consist for the greater part of diorite. Among these hills occurs a curious band of rock, 30 to 40 feet wide, consisting of a soft, bluish-white, crystalline mineral —a silicate, chiefly of magnesia—traversed by a multitude of small interlacing ribs of quartz. North of Sul Hamed the hills are formed chiefly of epidiorite rocks.

Jebel Gheiob consists of volcanic rocks, andesite, and at the base, fragmentary rock, the remains probably of volcanic ejectamenta. Jebel Robdanib consists of red syenite, but the well of Kamotit near here is in similar rock to that of Gheiob. Kamotit Well is about 30 feet deep, and said to be very ancient; water is plentiful but brackish.

Jebel Fanoi-dig consists of felsitic rock, displaying a distinct banded and in some parts a schistose structure.

Here also is an ancient, never-failing well, situated in a small amphitheatre in the heart of the hills.

Jebel Wiagrim and Gharad are both formed of red syenite, intruded through an older formation of coarse grey micaceous gneissose granite. Flanking Gharad on all sides are lower hills of finer-grained igneous character, chiefly eurites and porphyritic rocks, which latter may have resulted from extreme metamorphism among previously existing sedimentaries. A mile or two south of the main hill a bluish-grey micaceous clay-slate outcrops, the strike being 10° S. of E., and the dip steeply to the south.

The wells of Ariab, which contain a plentiful supply of sweet-water, are situated among low hills of grey gneiss. In the Wadi Kokreb the grey granite is seen beneath low hills of diorite and diabase.

Ancient Workings.—*Abu Hashim.*—Quite close to the railway and the river.

The Ancients have worked the narrower veins of quartz found here to a depth of 4 or 5 feet, and the wider veins have been prospected along their margins. The outcrops of white quartz have the appearance of segregation veins, but some of them can be traced for lengths of 100 or 200 yards; they vary in thickness up to 20 feet, but may be said generally to be 3 or 4 feet thick.

Island of Marru.—An island about 4 miles long and 1 mile wide, 42 miles south of Abu Hamed. The general rock formation is mica-schist, usually muscovite, of a light buff colour; but here and there are darker bands where the mica is biotitic. Bands of dark blue hydromica schist are also observed. The strike is north and south, and the dip west. Occurring in these schists at all angles, but chiefly parallel thereto, are an enormous number of quartz veins which have all the appearance of segregation veins. Some of the veins are pegmatitic in character, and contain fine crystals of mica of good colour and condition. The outcrops particularly at the north end of the island have been worked for gold, but it is probable that only the soft material was washed and that the quartz itself was not crushed. There are many remains of old huts, or tombs, built of burnt brick, and a fort, 200 feet long by 100 feet wide, with walls 6 feet thick, built of

stones laid edgewise instead of flat. Opposite this, across the western fork of the river, are the remains of an ancient barrage or causeway, the stones from which are now scattered over the river bed for some hundreds of feet down stream. Altogether the ruins have the appearance of very great antiquity, and this idea is supported in the crude and unmethodical character of the ancient mines.

Jebel Gheiob.—About 80 miles up the wadi Amur (lat. 19° 5′, long. 34° 45′). The deposit mined was a vein of white quartz with a "Comby" structure and inclusions of tourmaline. Six to 8 inches was probably the maximum breadth of the vein. The working is about 600 feet long, and for 520 feet from the northern end has been carried to a depth probably of 50 feet. Within a radius of 5 miles the Arabs report many other, but smaller workings.

Kamotit.—One and a half miles east and a little north of the main peak of Jebel Kamotit (lat. 19° 35′, long. 35°) are the ruins of a large camp which appears to date from mediæval days. On the hill sides are numerous shallow workings for detrital gold. No quartz veins of importance are visible, but there are numerous small veins traversing the rock, a felsite, in every direction.

Jebel Gharad (lat. 18° 56′, long. 35° 17′).—The mines are situated 3 miles west of the south-west corner of the high range. The rock is highly crystalline and has generally the appearance of dolerite; it is probably the result of extreme metamorphism on sedimentary rocks, and the quartz veins would hardly exist into the granite below. The old workings consist of shallow trenches along the outcrops of quartz veins which exist in two systems, one striking 20° N.E., nearly parallel with the longer axis of the low hill in which they lie, and the other striking 10° E. of N. across them. Both have been worked to considerable lengths, some of the latter for over a 1000 feet—the breadth of the hill. There are many huts and tombs here, but the quartz appears to have been washed at one of the many natural reservoirs of water which exist in the hills around; indeed, at the largest, 5 miles from the mines, are remains of huts and crushing stones.

Nigeim.—Five miles S.S.E. of Nigeim Well, 50 miles east

of the Nile at Abu Hamed. The ancient workings are 2000 feet long, on an irregular vein about 18 inches thick, and judging by the waste it is probable that some of the workings reach a depth of 150 or 200 feet. The old pits are now filled in by blown sand.

Nawarai (lat. 20°, and 110 miles from the Nile at Abu Hamed).—Here exist an old mining camp, the traces of very extensive trenching and alluvial workings over several miles. The veins although irregular and small are apparently fairly rich. One of the trenches is continuous for 500 feet, but does not appear to have been either wide or deep.

The quartz veins of Abu Hashim were developed, but the values and quantity proved disappointing.

The licenses of both concessions taken up by this Company expired on 30th September 1907.

EGYPTIAN SUDAN EXPLORATION COMPANY

(*Concession in Kordofan lying between latitudes* 10° 30′ *and* 12° 30′ *north; longitudes* 29° *and* 31° *east*).

Prospected by Professor LINK and Monsieur PEARLESS between 5th March and 18th May 1900, and by G. A. WRIGHT, Esq., between November 1902 and January 1903.

Geology. — The mountains composing the district are composed principally of granite, but crystalline schists predominate in the south and south-east districts of the Concession. The igneous masses are much worn down, and the detritus from them forms the great plain of cotton soil through which they protrude as "island mountains."

Jebel Kordofan is formed of granite, pegmatite, and mica schists. Jebel Kadero is formed of granite, but khors in the neighbourhood expose bedrock of gneiss and schist; the Ghulfan hills of gneiss, and graphite and quartz schists. East of Tagali the hills are composed almost entirely of schists. Jebel Moro is composed of granite and porphyry.

The native site of gold-washings at Tira-Mandi was

the only place visited where gold was found; no other deposits of valuable minerals or metals were discovered.

The Concession was abandoned 1st August 1903.

GABAIT MINING SYNDICATE, LTD.

(*The Sudan Mines, Limited*)

Prospected by Mr NOEL GRIFFIN and Mr W. H. SNELL in 1903, from 14th April to 15th July; 1050 miles traversed of which 794 were in the Concession.

Geology.—Igneous and metamorphic rocks.

"The rocks may be described as generally plutonic and basic much metamorphosed and weathered. Very little evidence of sedimentary deposition exists; but the metamorphism has resulted in much decomposition of the felspars and deposition of the carbonates of lime and magnesia in the form of ordinary limestone, dolomitic limestone, and dolomite."

Ancient workings for gold exist at:—

Akilebleigh	Gabatilo
Gabait	Rajarkindie
Wadi Oie	Ferukeit.
Tearomeur	

Akilebleigh.—Gold containing quartz discovered in the waste heaps of the ancient miners and in the pillars of quartz left in the vein. The old workings are two in number, about three-quarters of a mile apart, and not very extensive.

Gabait.—The workings are very numerous, cover about two square miles of ground; running around both sides of two hills and the reefs in them dip towards one another into the hills. One of the workings is 440 feet long and from 15 to 20 feet wide. In almost all the wadis in this neighbourhood there is evidence of extensive alluvial working.

Tearomeur.—A continuous line of working about 700 feet long; for about 300 feet the working is 20 feet wide, and this probably represents the total width of the vein.

Gabatilo.—Many workings; two of them from 80 to 100 feet long on a reef apparently 3 feet wide.

Rajarkindie.—Workings on a vein nearly 800 feet long, the quartz being 20 inches wide at the widest part. Many ruined houses and crushing-stones here.

Wadi Oie.—Extensive open old workings on veins dipping south at about 35°. On the principal vein the working is 675 feet long and 4 feet wide.

Ferukeit workings were not visited.

The assays of samples of quartz picked from the waste heaps of the ancient miners showed that at Akilebleigh, Gabait, and Rajarkindie particularly, rich ore existed.

Mining operations at Gabait started at the end of 1904 and ceased in 1907-1908.

A very rich vein of gold-bearing quartz was struck during the prospecting in depth, but milling operations upon it were not started.

The Company's prospecting license expired on 31st August 1908.

HEGATTE CONCESSION, JEBEL ELBA CONCESSION, AND G. OGILVY HAIG'S CONCESSION

Egyptian Sudan Minerals, Ltd., and Dareheib & African Syndicate

Prospected in 1902 and 1903 by Captain McCORMICK, and Messrs JOSEPH BADGE, H. LANCASTER HOBBS, and G. GRAVES GIFFORD.

Geology.—(No complete report was presented; the information obtainable is scattered through the printed reports.)

Around Hegatte the country apparently consists of intrusive granite in metamorphosed sedimentary rocks, mica-schists, dark coloured slates, and bands of crystalline limestone. Most of the quartz veins are segregates in the schists or contact veins between the granite and slates. At Ceiga the vein is a true fissure vein. The country here is similar

to that at Hegatte, but the slate is traversed by many quartz veins, sometimes running with it and sometimes across it. The Dareheib lode consists of massive quartz and veins, well mineralised, lying between schist and slate. The Jebel Elba area consists of granites, porphyries, felsite, and mica-schists, with some intrusive masses of diorite.

Ancient Workings.—*Dareheib*, in the Wadi Allagi, latitude 20°. The old workings consist of excavations to a probable depth of 150 feet in places on nine lodes, which traverse and intersect one another upon two adjacent hills, rising about 300 feet above the level of the wadi. The ancient character of these workings can be told from the fact that hundreds of tons of bat guano had accumulated in the old drives and stopes. The quartz varied in width from a few inches to 12 feet, and assays as high as 4 ounces to the ton of gold were made. There are many well-preserved ruins here, particularly of two castles built of slate cemented with mortar; and the large number of huts and crushing-stones showed the extent to which mining had been carried on.

Mining operations to develop the lodes below the old workings were undertaken, but the result was unsatisfactory.

Ceiga.—Near the western boundary of the Hegatte Concession. Two large open workings and many smaller ones on a true fissure vein between well-defined walls of talcose schist and slate. The outcrop is glassy and poor-looking, but in depth the quartz is iron-stained; the old miners worked principally in the lode material occurring in the schist formation, as the quartz was probably too hard for them to break down easily by the method of heating by fire and then cooling suddenly with water, which they adopted.

There are ruins for several miles in the wadi near this mine of sufficient number to have housed several thousand people, and a large number of crushing-mills and washing-tables.

At *Roumil* and *Giafferie*, about 30 miles north-east of Dareheib, there are very extensive ruins of ancient cities and old gold-workings. On the west side of the Demetri Hills many old gold-workings exist; and in the Wadi Allagi, north-west from Dareheib, old gold-workings are particularly

numerous, especially near Jebel Defait, Jebel Hyan, Alfowie, and Jebel Hegatte.

At *Alfowie* the chief workings are on a large outcrop, which has been worked from the base to the summit of a hill 900 feet high, and a great distance down the other slope, a distance of about 2000 feet. Many other workings and outcrops are scattered around this centre.

Besides these mining operations there are traces all over the Concession of ancient search for alluvial and detrital gold.

Onib Mines.—Latitude 21° 30′, longitude 35° 20′.

Near Jebel Onib the old workings consist of numerous excavations on two main lodes, bearing N. 40° E. and dipping 80° to the north, traceable for 1000 feet and 600 feet respectively. The quartz varies in width from 18 inches to 3 feet, but is poor in quality. West of these lodes are others that have been worked by the Ancients for distances of over a quarter of a mile. Hut ruins and crushing-mills are numerous; but the crushed quartz was apparently conveyed elsewhere for final treatment, since water is scarce here. Mining operations started here on 11th November 1905, and were discontinued during the summer months of 1906, and the mine was abandoned in May 1907, as the prospects were not promising.

The Dareheib and African Syndicate, the only company of the above three holding a concession within the political boundary of the Sudan, relinquished their license, 1st October 1908.

The Hegatte Concession and Jebel Elba Concession licenses have also expired.

LONDON AND SUDAN DEVELOPMENT SYNDICATE

Prospected by Mr C. K. DIGBY-JONES in 1901-1902; in 1902-1903 by Mr DIGBY-JONES and Messrs SEAL and GREAVES; in 1903-1904 by Mr ACKERMANN for Messrs BEWICK and MOREING, Mining Engineers; and in 1904-1905 by Mr J. H. MEANS.

Geology.—"The eastern range of mountains, forming the watershed of the river system, consists principally of granitic rocks—and there appears to have been a sedimentary series formed from the decomposition of granitic and hornblendic rocks, this sedimentary series being subsequently altered by further intrusions, chiefly of granitic character.

"The intrusive granite, through shearing action, has been in many cases altered to gneiss; and this material is often traversed, more especially in the Khor Adi, by numerous stringers of quartz.

"Hornblende rock with local transitions to quartz diorite, forms hills in various parts of the Concession, notably in the Khor Adi and at Ghezan.

"Where the country has been eroded in the khors, slates are almost always, if not universally exposed; and these are generally chloritic, the chlorite being due probably to the alteration of hornblendic material arising from the weathering of the hornblendic rocks. These slates are in many instances specked with iron pyrites (which may also be the result of the decomposition of the hornblende) and arsenical pyrites. There has been a large amount of regional crushing and contortion of the slates, which are remarkable for the frequent occurrence of irregular lenticules of quartz in the deposition planes.

"This is more especially the case in the Khor Adi, the bed of which is very much cut up by outcrops of chloritic slates and gneiss; the strike being approximately N.W. and S.E. Parallel with the quartz stringers in the slate, occasional veins of calcite are met with; these, like the slates and quartz, also carry iron pyrites."

"In the Fazogli district the country is almost entirely of an igneous character, except for schists and a few comparatively recent deposits of freshwater sandstones. Speaking broadly, the country consists of intermediate igneous rocks, among the most common being diorites, syenites, and porphyrites. These have been intersected by dykes and intrusions of granites with a general north and south strike. A constant feature of the country is the occurrence of veins of pegmatite and graphic granite. No actual evidence is seen of a true volcanic character.

"The larger mountains in the Fazogli district chiefly consist of quartz diorite, and in the lower ranges surrounding these and covering extensive areas, the diorite becomes finer in texture, passing imperceptibly into gneiss and that into schists, traversed in all directions by dykes and intrusions of greenstones, felsites, and porphyry; it is in this section that the auriferous quartz veins appear to be."

Discoveries of Gold.—The natives carry on gold-washing during and immediately after the rains, until the time comes to harvest the durra. The principal khors in which operations are being carried on at the present time are:—

Khor Adi—		source	J. Falabut
„	Shamborun	„	J. Falabut and Fasankaru
„	Sultan	„	J. Falabut and Fasankaru
„	Masurkum	„	J. Ragreig
„	Gargiu	„	J. Ragreig.

Gold-bearing gravel is found in the following khors:—

Khor Annis Shangani—		source	J. Fazogli
„	Amora	„	J. Faronge
„	El Dahab	„	J. Faronge
„	Barmirzogli	„	S.W. of J. Faronge
„	Sumba	„	J. Falabat
„	Maganza	„	J. Keili
„	Zalan, and others	„	Beni-Shangul.

Traces of gold are found in the Khor Tumat in the neighbourhood of J. Fazogli, and from the fact that many khors in which gold-bearing gravels are found empty into the Tumat, it is possible that in the bed of the khor pay-

able deposits of gravel may occur ; there is, however, a heavy overburden of coarse sand.

"Exclusive of Khor Tumat except for a very short distance from the point of their junction with the Khor Tumat, none of the khors present any facilities even in the wet season for mechanical appliances, as the beds are much broken up by boulders and outcrops."

Old Workings.—*Jebel Faronge*, situated about 5 miles south-east of the village of Amora, and about 10 miles north-east of Ghezan. The main workings are on a low rounded hill rather more than half a mile west of the mountain, and close to one of the branches of the Khor Amora. The workings consist of a number of scattered pits and irregular shafts from 3 to 20 feet deep: no age can be assigned to them, but it appears likely that they are comparatively recent, possibly the result of Russegger's expedition, and therefore sometime after 1840. Russegger relates that a supplementary expedition was despatched by the Egyptian Government, but that this failed owing to mismanagement and fights with the natives.

The deposit occurs in a more or less schistose formation, probably the result of the weathering of chlorite slate. "This schistose formation is traversed by several small, well-defined dykes, but the chief characteristic consists of bodies of felsitic material in the neighbourhood of these dykes; these bodies at surface are irregular and gradually merge into the formation, but in them occur stringers and impregnations of gold-bearing quartz.

"Other gold-bearing quartz also occurs as stringers and lenticulæ enclosed along the cleavage planes of the schistose formation."

Work undertaken by the Sudan Development Company failed to discover any important ore-body here.

Gold-bearing deposits.—"*Bully Hill*," on the Khor Dahab, 5 miles south of Faronge and 8 miles east of khor Tumat.

"The deposit appears to be a series of irregular quartz lenses, in a highly metamorphosed quartz porphyry. The strike is east and west, and the dip at about 40° to the north. The quartz is fairly well mineralised with galena,

BURRTA WOMAN PANNING GOLD-BEARING GRAVELS. FAZOGLI DISTRICT.

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which in places is very much decomposed; the principal gold values being found in this highly decomposed material."

Development work here proved that the ore was not sufficient or rich enough to work.

Gold *in situ* was found, but not in payable quantities, at J. Mogoga and J. Kukuli (the first site is not marked on the maps; probably the name is wrong), where quartz stringers in the pegmatite were found to contain a little gold.

The Company's license expired on 31st August 1911.

NUBIA (SUDAN) DEVELOPMENT COMPANY

Prospected by Mr PEREGRINE WILSON and Mr A. MACKINNON between 26th March and 1st June 1903, subsequently in the winter season of 1904.

Geology.—(Not described in detail.) Nubian Sandstone formation extends over the whole of the area, with masses of igneous and metamorphic rocks occupying certain districts, especially near the river.

Around Jebel Abu Zari the country is composed of low hills of granitic and other holo-crystalline rocks with many quartz blows; a similar formation extends from south of Jebel Hamra as far as Kuror.

The country around Om Fahm is composed of igneous and metamorphic rocks consisting of grey slates, massive slates, and igneous dykes and micaceous, chloritic, and hornblendic schists intersected with quartz veins. Around Haisub the rocks are almost entirely greenstones, hornblende, chloritic and mica schists, with here and there granite rocks and numerous veins of quartz many of which are auriferous. Around Sarras the rocks are igneous.

Ancient Workings.—*Om Fahm.*—About 5 miles from Adila Wells.

The workings are not particularly extensive, and appear to be on a cupriferous quartz vein. They are about 3 feet wide and 180 feet long, filled in with blown sand. A sample collected here contained 1 dwt. 4 grains of gold to the ton.

Haisub.—Twelve miles from Adila Wells, 30 miles due east of the Nile. The ancient mining works are situated on low hills of soft igneous shales, and extend over a district measuring some 3 miles in length.

The auriferous quartz veins are very numerous, run in a direction nearly north and south, and vary from 2 inches to 2 feet in width, but are generally narrow. The workings of the Ancients extended to about 30 feet in depth.

Sarras.—Situated on the north and south sides of Wadi Achmed Sheru. The veins run east and west, are numerous, and vary in width from 1 inch to 3 feet.

Doshat.—Near Ambugol and Bringol mountain. Several hundred yards of open cut upon a quartz vein running E.N.E., dipping 30° from the horizontal.

Within a few miles of this main working are other important old workings on other auriferous veins.

Developing operations at this place were started in January 1904 and continued until March 1905, opening up a moderately rich vein beneath the old workings.

Abu Sari.—Near Dalgo. Numerous important veins of gold, all apparently auriferous, running in a general east and west direction. Quite close to the river. Development work was started in April 1904 upon the "main reef," and stopped in March 1905.

In *Wadi Sohr*, near Ambugol, the district of Ginnis south of Kosha, between Suarda and Irau, and at Jebel Hamri and other places, traces of ancient gold-mining were discovered.

Dafoufah.—About 4 miles south of Kerma. "This is an ancient centre, where smelting and refining must have been carried on, perhaps for centuries. There are enormous mounds of broken crucibles and slag. The smaller clay crucibles found here are exactly similar to those used for assaying and refining gold in the present day; and there are also larger crucibles similar to those used for smelting ore now.

"Many hundreds of tons of this crucible refuse is deposited here, one large mound being at least 90 feet long by 20 feet high, and there are many outlying heaps.

"There are also squared stones, some of which are granite, which must have been brought a long distance; and it is probable that regularly conducted excavation here would be

well rewarded, and valuable data as to old mines and methods of mining and smelting might be unearthed. About a quarter of a mile from this large deposit of crucibles is an enormous kiln of sun-dried bricks nearly 50 feet high, and about a mile east of this there is another which appears exactly similar.

"The crushed ore was brought from the mines to this place for smelting."

At *Adila* there are extensive old workings for iron.

The Concession expired on the 31st August 1907, the Company going into liquidation.

THE SUAKIN MINING SYNDICATE

Prospected by Mr A. P. GRIFFITHS in the autumn of 1904, and by Mr JOSEPH ESLICK in March 1905.

Geology.—"The rocks forming the geology of the district belong to nearly every class of volcanic and igneous rocks. If we consider an ideal section taken across the range of mountains, along a line at right angles to the general trend, *i.e.*, about east and west, and proceeding in a westerly direction, we find that the basement rock of the sea plain and of the hills is grey granite mostly, both fine and coarse grained. This granite formation seems to dip rather flatly to the west, and as a higher altitude is attained, it is replaced gradually by gneiss, syenite, mica, and talc schists, clay-slates, etc. In numerous places the strata are uplifted or pierced by large masses of intrusive rock such as diorite, gabbro, diabase, and occasionally andesite.

"On the eastern side, *e.g.*, in the region of khor Sitarab, the granites contain numerous quartz stringers, leaders, and reefs. In places these give way to large lenticular masses of quartz and pink felspar in large crystals, the whole apparently being a manifestation of pegmatite. These quartz reefs occasionally show a slightly honeycombed outcrop, but generally consist of very fine white-grained or of glassy, resinous-looking transparent quartz. In very few

cases do they show symptoms of any mineralisation, and the absence of such would lead me to suspect a lack of gold-bearing contents.

"Numerous masses of quartz are found outcropping or underfoot at innumerable points on the property, but especially in the southern portions of the Concession. This quartz is found *in situ* in the shape of lenticular masses or 'bosses' in the intrusive rocks, and occurs apparently along certain rough parallel lines of strike, which, although not constituting real fissures, probably were lines of weakness in the rock along which the silicious underground waters may have circulated and deposited the quartz. It may also be that the quartz has separated by 'segregation' or 'magmatic separation' from the molten mass of igneous rocks. This would appear to be the more probable origin of the quartz."

Ancient Workings.—At *Togni*, *J. Tahuna*, and *J. Hofra* insignificant ancient surface scratchings on irregular veins or blows of quartz were discovered, but the quartz proved to contain hardly more than a trace of gold. No discoveries of any importance were made in this district.

The license was surrendered on the 31st March 1906.

SUDAN GOLD FIELD, LIMITED

Prospecting work, under the supervision of Mr ARTHUR LLEWELLYN, was started in November 1901, and additional explorations have been made during the winter seasons for some years past, but without making any very important discovery. Actual mining operations were started at *Nabi* in May 1902, and continued to the end of May 1903; at *Om Nabardi* in November 1901; a crushing mill was erected in the winter of 1908, a trial crushing of ore made in May 1908, and since September 1908, crushing has been practically continuous. Up to the 31st December 1910, the value of the gold obtained and sold was £45,308, 10s. 11d.

Geology.—(Summarised from Mr Llewellyn's Report, 1903.) The geological structure of the country may be briefly described as a foundation of grey granite merging

into gneiss, and supporting, with apparent uncomformability, an extensive series of micaceous, talcose, and hornblendic schists and shales, clay-slates, and crystalline limestones. Above these, with probably a long break in geological age, a formation of conglomerates, sandstones, argillaceous limestones, and various coloured shales; and above these again, in distinct uncomformity, the marls and sandstones of Cretaceous age, now so well known under the name of Nubian Sandstone. Among the older rocks described are broad areas of igneous rock which in many cases appears to be intrusive, while in others, and especially among the more basic varieties, the balance of evidence seems to point to a contemporaneous origin. Intrusive dykes are common in the granite and in the older schistose series; but in the second group of sedimentary rocks no certain and conclusive evidence of igneous intrusion could be found, and the upper or Cretaceous series appear to be entirely undisturbed. It would thus seem that igneous agencies played a great part in the formation and deposition of the older schists, while the period represented by the break between them and the succeeding group would appear to have been one of great volcanic activity.

In lithological characters the schistose rocks resemble in many respects those of Cambrian age, although conceivably of an earlier date. Those of the second group have their nearest lithological counterpart, perhaps, in upper Silurian rocks; but as no very diligent search for fossils has been made, no palæontological evidence is forthcoming to support this hypothesis.

Granite.—This is the oldest and most extensive formation. In some of the hills and under many hundred square miles of sandy plain it is of the common grey type, the mica being almost invariably biotite. Where it can be followed into the succeeding formation the latter is found to be a coarsely foliated gneiss, often hornblendic, and containing spherical inclusions of darker crystalline hornblende schists. As a rule the surface is denuded, and the transition is to a rock of much more recent age. No considerable areas of typical gneiss were observed in the Concession, and the rock seems to be confined to marginal transitions of the old grey

granite. Over certain areas, and particularly in the larger hill masses, granitic rock of another character is seen, the mica being replaced by hornblende, and felspar predominating to the almost entire exclusion of quartz, so that it is difficult to decide whether to class it as granite or syenite. The felspar continues monoclinic, but the colour has usually changed to a bright pink. It is considered that this rock is of more recent age than the grey granite, and it has the appearance of being eruptive and intrusive, forming as it does isolated hills amongst stratified rock, and the centres from which many euritic dykes can be traced into the surrounding country.

Schists.—Next in order to the gneiss is an arenaceous schist, between which and the granite, however, gneiss does not invariably intervene. In this rock massive bands of quartzite are common. Bands of arkose also occur, but are less conspicuous. Above these are a series of clay-slates alternating with more or less schistose rocks, sometimes talcose, but oftener chloritic and micaceous. These are succeeded by more calcareous rocks, the purer varieties of which have been metamorphosed into a coarsely crystalline marble, while others have been compressed into a tough, amorphous rock which in appearance and fracture resemble the finer varieties of trap. At El Eshbab the limestone occurs directly on the granite; while at Abu Hamed a white, crystalline marble appears to be actually interbanded with gneiss, and has been followed to some depth for the purpose of lime-burning.

Sedimentaries.—The basal member of the second group appears to be a coarse conglomerate, consisting of well-worn fragments of the older rocks cemented in a dark compact matrix which is itself semi-crystalline. Above this is a calcareous sandstone, with numerous thin bands of more silicious character which have been changed into hard quartzite. There is evidence of great pressure and contortion, although no distinct intrusion of igneous rock has been observed. Succeeding these are a series of coloured shales, more or less calcareous, above which is an extensive formation of dark blue argillaceous limestone. The series is much tilted and shows evidence of great regional compression; but

there is no evidence of that acute contortion observable in the silicious rocks below.

Nubian Sandstone covers a great part of the north-western quarter of this Concession, forming a high plateau from which rise occasional exposures of the older rocks. Isolated outliers are found all over the Concession. The basal member of the sandstone series is a light-coloured quartz conglomerate, apparently of sub-aerial formation, in which the fragments are little worn.

Igneous.—Except the granitic varieties already described these rocks can be divided into two classes, according to their lithological characteristics, not their supposed origin or mode of occurrence.

The first includes the crystalline diorites, gabbros, and diabase rocks usually associated with the older schists, while the second comprises the more glassy and lithoidal varieties —the felsites, basalts, and porphyrites, which in many parts extend in unbroken sequence over hundreds of square miles.

No fact is so clearly evident than that the occurrence of gold depends primarily on the presence of an igneous rock, intrusive or otherwise; to look for it elsewhere may be regarded as a waste of time. This fact was evidently as apparent to the ancient workers, for although the area from end to end bears evidence of careful prospecting, some of which was no doubt unsuccessful, the scene of work, except in the case of alluvial deposits, was never far removed from the areas of igneous influence.

Associated with these rocks, notably at Nabi, Om Nabardi, Um Gat, and Khabaseit, are very considerable developments of a tough, greyish-green, micaceous and chloritic schist which displays a characteristic prismatic structure. In and around Murrat the indications point to a widespread plutonic upheaval among previously deposited sedimentaries, parts of which remain included, while at Sinayat the appearance is that of intercalated lava-flows. The hill ranges of Tana Shaib, Kermai, Butna, and Barid are the result of a far-reaching extravasation of volcanic matter long after the deposition of the older schists. They vary in texture from coarse porphyry to a dark green aphanitic rock, which has been classed as andesite. Olivine and pyroxene are common

constituents. East of and around Labasoi is a big spread of acid igneous rock, probably euritic felsite.

Iron.—Associated with many of the older limestones are irregular deposits of hæmatitic limonite. One of the biggest of these is seen capping a white limestone range west of Jebel Labasoi, and between that hill and Wadi Terfowi. Bands of compact but rather silicious limonite are also found in Jebel Rafit, at the base of the Nubian Sandstone, and these at places appear to have been a little worked.

Gold. **Ancient Workings.**—The ancient mines examined may be divided into three classes:—

First—Alluvial.
Second—Shallow Trenching.
Third—Vein Mining Underground.

The mines worked for alluvial gold sometimes extend almost continuously over several square miles, and consist of a multitude of shallow pits sunk through a stony burden to the rock beneath, which probably supported a substratum fairly rich in gold.

The second type of mines almost always occurs in a distinctly igneous rock—often a porphyritic felsite. Here the gold occurs in narrow bluish-white quartz veins, the small width of which precluded their being followed in depth. It is possible too that these trench works were wrought by a people who had no knowledge of the art of subterranean mining. M. de Bellefonds Bey considers that the Arabs of the Middle Ages were fearful of working underground; but the important mines of Ceija are almost certainly of Arabic creation. From the evidence of Cufic inscriptions, the prevailing type of ancient pottery discovered in the mines, and the names of the localities, Mr Llewellyn is of opinion that most of the mines (third type) must be referred to the period of Arabian occupation.

The ancient mining sites discovered in the Concession are:—

NAME.	CLASS.	LATITUDE.			LONGITUDE.		
Abu Dalala . . .	2	21°	47′	30″	34°	28′	15″
Abu Siha . . .	?	20	35	25	33	2	45
Abu Tundul . . .	1	21	38	50	33	40	20
Adarawib . . .	1	20	25	10	33	6	0
Bir Towil . . .	1 and 2	21	51	0	33	47	0
Butna	2	21	45	0	34	30 & over	
Dabhalkaa . . .	2	21	1	0	33	59	0
Dayob	1 and 2	21	9	25	33	0	0
Esmat Omar . . .	1	21	49	20	33	43	0
Um Fitfit . . .	1	20	46	0	32	27	10
Hadal Moiet . . .	1 and 2	20	30	45	34	1	10
Idarib	1 and 2	21	6	30	33	25	20
Khabeseit . . .	1, 2 and 3	21	7	45	33	55	45
Lesewit	2	21	25	10	33	40	0
Mosei	1 and 2	21	10	30	33	7	0
Mundera . . .	1 and 2	20	55	40	32	46	10
Nabi	1, 2 and 3	21	13	20	33	11	40
Nabi Tana . . .	2 and 3	21	9	45	33	35	30
Nasb-El Hosan . .	1	20	35	40	33	17	25
Omar Khabash . .	1	20	13	0	33	18	20
Om Nabardi . . .	1, 2 and 3	21	7	30	32	46	0
Rod-el-Ushal . . .	1	20	40	10	32	37	40
Shashu-at-eb . . .	1 and 2	21	40	30	34	10	40
Tana Shaib . . .	2	21	12	15	33	35	30
Terfowi	2	21	1	20	34	2	25
Tilat Abda . . .	1 and 2	21	20	0	33	37	0
Ufain	1 and 2	21	47	30	34	23	30
Wadi Dom . . .	1 and 2	21	15	0	33	40	0
Wadi Howe . . .	1 and 2	21	46	45	33	42	20
Wadi Romeit . . .	1	21	15	40	33	37	10

Abu Dalala.—Extensive workings and remains of ancient occupation in a wadi between Jebel Abu Dalala and Jebel Uffain. Butna workings are close to this site.

Jebel Dayob.—8 miles N.W. of Murrat. Small veins of quartz have been worked here and not the main vein, which is 600 feet long and from 3 to 10 feet wide, carrying a trace of gold only.

Um Fitfit.—9 miles west of No. 6 Station. The question of what metal or gem was mined here so extensively has not yet been decided. The workings are principally confined to the limestone which occurs in the schists. Alluvial gold-workings are found near small quartz veins in the latter rock.

Idarib.—6 miles S.S.W. of Jebel Kerar Berat, among the low flat hillocks bordering the north-eastern side of the Wadi Idarib. Most of the mines are obscured by blown sand. An inscription in Cufic characters on a tombstone found here gave the date 307 Muharram = A.D. 918.

Khabaseit.—20 miles slightly north of east from Jebel Idarib. At the head of Wadi Khabaseit are many pits and deep long trenches upon veins of quartz from 2 to 3 feet wide, carrying 4 dwts. of gold to the ton. The excellent preservation of the old huts and crushing-mills point to a hurried evacuation of this site by the old miners.

Lesewit.—At the head of Wadi Lesewit, 10 miles above the Tilat Abda wells. A continuous working 110 feet long upon a vein of iron-stained quartz 18 inches wide. Near this are other trenches upon small veins of rotten quartose rock, much iron-stained. Here there is evidence of a small semi-circular dam across the valley for the storage of water.

Nabi.—2 miles north of the wells, near Jebel Nabi. The workings, consisting of pits and trenches, extend for about one mile on veins and stringers of iron-stained quartz from 1 inch to 18 inches in width.

Nabi Tana.—7 miles S.S.W. from Nabi. Workings open to a depth of 40 feet in places, and extending for a length of about 750 feet, upon kaolinised bands of a porphyritic dyke containing small veins of silicious limestone.

Om Nabardi.—28 miles from No. 6 Station, with which the mine is connected by a narrow-guage railway.

"The prevailing rock is a coarsely laminated schist, micaceous and chloritic, sometimes talcose, and less frequently with much actinolite. Associated with this is a harder and less altered rock which is more distinctly igneous. The one seems to merge into the other, but at places dyke-like bands of the latter are seen to traverse the schists, although such apparent dykes have not been found to penetrate the reefs. The mean strike of the foliation is E.N.E., and the dip towards the south. The reefs are irregular in size and strike, varying from a mere leader up to 20 feet, the larger developments forming the backbone of several of the hills. They appear to be fairly continuous, and can be traced for lengths of 1200 to 1500 feet. The principal group consists of two main reefs with several offshoots, and a diagonal reef which may connect the two." The ancient workings here extend over a length of 1400 feet, and have been discovered to go down as much as 130 feet below the surface. The large number of huts, crushing-tables, and the remains of furnaces and slag show the extent to which this site has been worked. It is possible that there were two periods of ancient exploration; and a period of individual effort, rather than of organised labour, undertaken by the Arabs.

Shashu-at-eb.—At the head of the wadi where it leaves Jebel Hajarreib. The main working consists of a trench 450 feet long and 30 feet deep in places upon a vein of quartz in a fine-grained porphyritic rock. The secondary working is 1 mile west of this, and consists of two trenches 75 and 180 feet long, along a very small quartz vein at the contact of a porphyry and a basaltic rock which may be intrusive.

Tana Shaib.—About 11 miles up the Wadi Tana Shaib from where it joins Wadi Gabgabba. Eight trenches, the longest of which is 600 feet upon a network of very narrow quartz veins in a band of decomposed felspathic rock.

The Sudan Gold Field Company confines its work at the present entirely to the extraction of gold from the Om Nabardi Mine ore, and the development of that mine underground.

SUDAN EXPLORATION COMPANY

Prospected by Mr ARTHUR THOMAS for Messrs John Taylor & Sons, Mining Engineers, in the winter season, 1903-1904.

Geology.—"The Coastal Plain consists apparently of coral reefs covered with detritus, gradually rising to the foot hills. These in turn give place, going westwards, to higher ranges of granite, much disturbed by later igneous intrusions. Towards the southern, central, and western parts of the Concession, and especially in the Khor Omeg district, are found crystalline schists and many bands or belts of marble.

"The reefs discovered mostly occur in association with igneous dykes, and generally in granitic areas; but some were in the schistose districts, and others in close relation to the bands of crystalline limestone."

Ancient Workings for Gold.—*Shanobkwan.*—The principal trench is 420 feet long and perhaps 40 or more feet deep; the vein discovered in various places by development work averaged 20 inches wide, and assayed 10 to 15 dwts. to the ton.

Other smaller workings were discovered at :—

Rome.—1½ miles N.W. of Shanobkwan, where an exceptionally long, narrow, open cut was discovered; and from the very large number of mills and remains of houses, the place was judged to be a great centre of ancient mining activity.

Tembilass.—About 2 miles N.W. of Rome. Small workings on a narrow irregular vein. Again 2½ miles west of this, on top of a very high granite hill, very extensive old workings were found.

West of Tembilass alluvial workings exist.

Tempini.—In Khor Mugwalla. A rich but irregular vein occurs.

Near Shanobkwana, at points 1½ miles west; at *Karyos*, 7 miles west, 8 miles N.N.W.; *Camédé*, 7 miles north, and at the well, old workings were found upon veins of gold-

bearing quartz. At the following places also traces of ancient mining were discovered:—

Khor Hadot.—Close to the northern boundary of the Concession.

Khor Garar.—About 6½ miles west of *Hadot; Tecommoi* and *Wokilah*, near Shanobkwana; *Tarbilah*, 12 miles S.W. of Tembilass. "The quartz discovered here is considerably stained by copper carbonate—this is one of the few places where visible gold in the quartz could not be found."

Selobi.—14 miles west of Tarbilah.

Khor Dad.—7 miles west of Selobi.

Tedanti.—15 miles N.W. of Khor Dad.

Issareah or *Adalowarti.*—6 miles S.W. of Shanobkwan.

Khor Umbarada.

J. Deimait.—Two extensive surface workings on the west and south-west slopes.

A little north of Khor Mishdat.

Tediolai.

Galcami and *Torré.*—On the left bank of Khor Arbat. Some small open cuts and remains of mills and houses. The quartz here, as at Tarbilah, showed indications of copper.

The Concession was surrendered to the Sudan Government in April 1906.

Note.—Most of the above places cannot be identified, but they apparently lie in the Sotriba and Akareiriba districts.

TOKAR PROSPECTING SYNDICATE, LTD.

Peregrine C. Wilson, Esq.

Prospected by Mr W. H. SHOCKLEY and Mr J. F. MORRIS in 1905, from 30th January to 3rd April and 28th April to 5th May—1150 miles of route covered.

Geology.—"The eastern portion save for the sandy coastal strip consists almost wholly of contorted and highly metamorphosed rocks, schists, and phyllites. These have been considerably intruded by numerous dykes in which

the abundance of epidote is noteworthy. In a few localities, notably near Karara and at Kata Idris, underlying or intrusive granites are exposed.

"The geology of the western portion is much more complex, diorites and granites having intruded older sedimentary and sometimes igneous rocks, folding and changing them to gneisses, phyllites, and schists, with an occasional thin band of crystalline limestone. The result is an almost inextricable tangle. Quartz reefs, the result of folding and fissuring, are abundant.

"Occasional patches of horizontally lying conglomerates and coarse grits occur, more particularly in the neighbourhood of Jebel Hambolib at the northward turn of Khor Langeb. Here also occur flows of basalt and porphyry of later age; and it is probably to the preserving influence of these that is due the survival of the conglomerates and grits in the neighbourhood."

There are no old workings in the area of this Concession.

Minerals discovered.—*Coal.*—At the summit of the pass of Katai Mintab a band of black graphitic material a few inches thick, embedded in contorted schists, was discovered. Mr Morris gives it as his opinion that it possesses no value as a fuel, since it resembles a material he had seen and made many experiments with in Korea, probably graphite.

Copper.—(1) In Khor Areirib, where the road over Katai Hamat rejoins the khor, occurs an outcrop of quartz standing 12 feet above bed of khor, 13 feet wide and 80 feet long. This quartz shows copper stains.

(2) In Khor Hamrik, at the end of the camel track up the khor, on the left bank and 75 feet above the bed, is a 15-inch band of copper-stained schist and quartz.

(3) In Khor Areirib, about 1 mile above junction with Khor Delisha, in bed of khor on right bank. A quartz lode carrying copper carbonate and copper pyrites traceable 150 feet, with average width of 5 feet, dipping 50° west.

(4) In Khor Agarin. On right bank, on track around Habrah wells, occur several bands of copper-stained schists. The most important is an impregnated band about 120 feet wide and 200 feet long, dip W.N.W. 45°.

Copper-stained schists and quartz lodes were also dis-

covered on (1) the road from Jebel Gwerar Gwobiab to Gwobiab Well (Abu Nakhl); (2) 2 miles W.N.W. from Khor Adarid, near Jebel Gwerar Gwobiab; (3) 1½ miles up Khor from Abu Nakhl wells; (4) near the water-holes in Khor Gidmut and on east flank of J. Haina; (5) at junction of Khor Sharag and Khor Adaramat; (6) in Khor Mashail throughout, above junction with Khor Shalalta; (7) several points in Khor Areirib other than the two important discoveries mentioned above; and (8) in Khor Delisha.

The Company's prospecting license expired on 30th September 1905.

THE VICTORIA INVESTMENT CORPORATION

Prospected by Mr STANLEY C. DUNN between 2nd November 1905 and 3rd February 1906.

Geology.—Nubian Sandstone formation over the whole of the area. At Jebel Bayuda exists a large outcrop of grey gneissose granite merging on the south side into reddish and brown felsite and porphyrite, while for some miles around and especially towards the north-west the denudation of the sandstone has exposed coarse grey gneiss and a very coarse mica-schist. Both the gneiss and schist are veined and much contorted by intrusions of pegmatite and graphic granite. There are some large blows of quartz but no true quartz veins; none of the quartz discovered is mineralised to any visible extent and does not carry gold.

The Shabluka hills on the river are composed of felsite and rhyolite, with grey gneissose granite and reddish syenitic granite outcropping on the south-west corner of the mass. The long range of Jebel Gilif forming the northern boundary of the area is composed principally of felsite and rhyolite, the latter a very pale yellow in colour.

On the north-west corner of the Shabluka hills, near the village of Hogani, a very large vein of quartz exists, traceable in a due north and south line for 6700 feet, and varying from

a couple of feet to over thirty in width. There are no traces of old workings on it, and on examination no gold or other mineral could be panned out of the quartz.

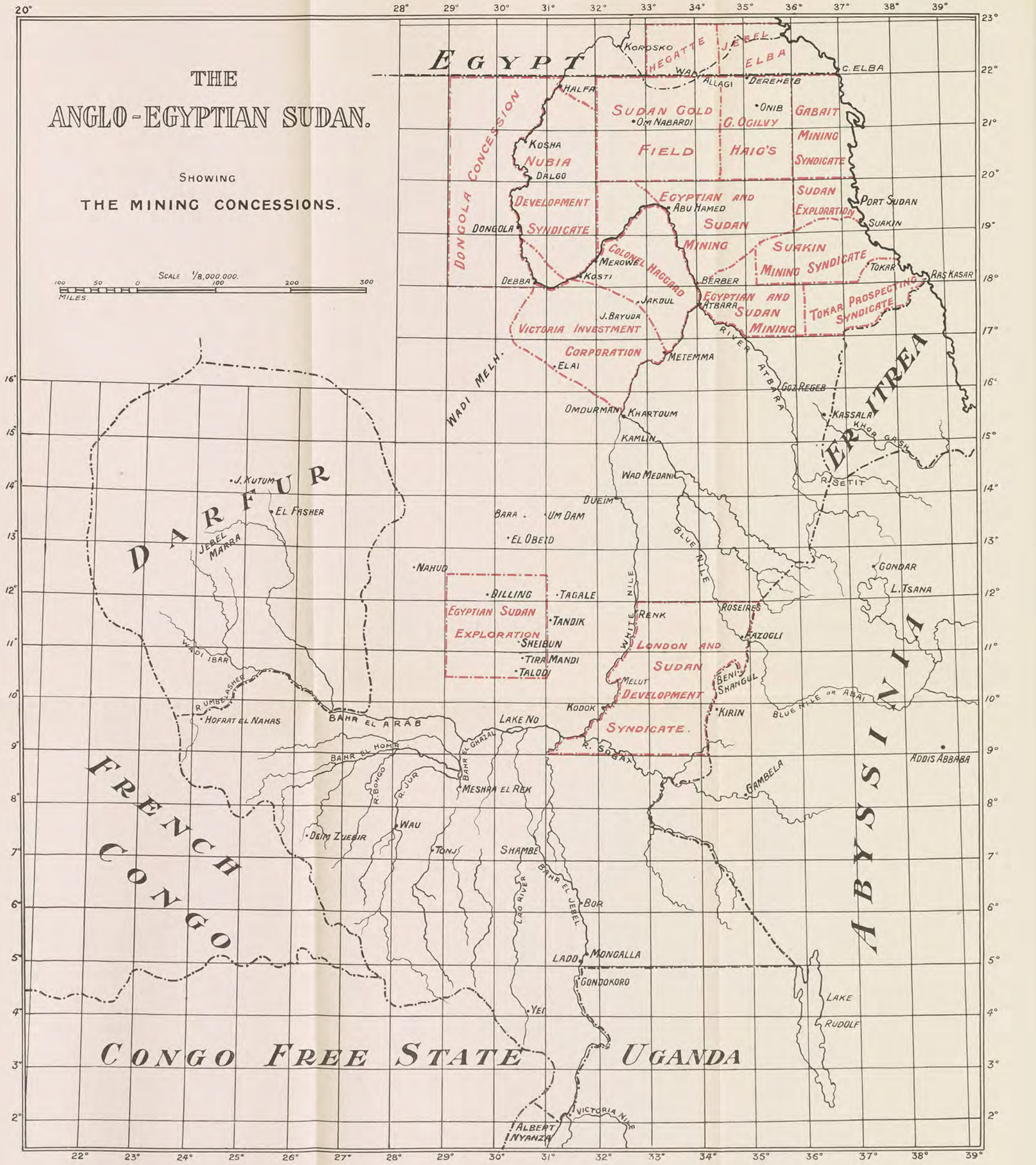
There are no signs of ancient gold workings in this area, and no new discoveries were made.

The license expired 31st August 1906.

THE ANGLO-EGYPTIAN SUDAN.

SHOWING

THE MINING CONCESSIONS.



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